NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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SCIENTIFIC METHOD IN PROPAGANDA

THE word 'propaganda' is defined in the Oxford Dictionary as "an organized scheme for propagation of a doctrine or practice" ; unfortunately it has acquired a bad, and recently an even sinister, meaning. There are few things from which the scientific worker reacts more instinctively than propaganda. Indeed, his wholesome and genuine prejudice against the word has sometimes led to less than justice being done to the work and abilities of those of his colleagues who have undertaken the task of expounding or interpreting to the world the results of scientific work and their significance for human welfare. There are spheres in which the essential task of education is not readily distinguished from propaganda, and propaganda itself has its uses as well as its abuses. Even societies which exist primarily for research and inquiry may fail of their purpose if they neglect to bring to the notice of the public whatever results have been obtained.

Prejudices which refuse to recognize the right use of an instrument may have consequences as untoward as those which condone abuse, and scientific workers cannot be entirely absolved from responsibility for the consequences of neglect of the important task of exposition. It is not enough for the Government to make even full use of the service of scientific men in the evolution or execution of a policy. Co-operation of the public is also involved to the extent that it demands an intelligent understanding of the policy, and for this an immense campaign of education is essential.

In their own particular studies, scientific workers have as yet given nothing like the attention to this question that is desirable on general grounds, or, in certain fields such as food supply, that is now essential for the development of our war effort. Some aspects of this work may fairly be regarded as falling within the field of the Ministry of Information, but scientific workers are not entitled to criticize the Ministry unreservedly for shortcomings unless they have made their own contribution, or at least put forward constructive proposals. The dissemination and use of information, as much as the acquisition of information, require scientific study and the application of scientific methods.

This is not a matter which can be left entirely to information services. Their special function is the locating of information and its handling in the most efficient form. Only to a limited and technical extent are they concerned with the form in which it is presented or the use to be made of it. The educational aspect lies almost entirely outside their scope. There are features in the present situation, however, which demand the attention and co-operation of scientific workers.

The question of food supply and policy is only one, though probably the most prominent, of the matters in which inadequate use has been made of

the services of scientific workers, and insufficient guidance has perhaps been given by them. Nor is it alone in being essential for the efficient prosecution of our war effort. Lord Chatfield's statement early in the year regarding the co-ordination of the scientific research carried out by the special departments of the Fighting Services and of the Ministry of Supply only partly dispelled misgiving as to the use being made of scientific services in the immediate task of national defence. In many other wide fields similar concern may be felt with even more reason. The recent report of the Industrial Health Research Board of the Medical Research Council on industrial health in war emphasized the need for applying knowledge already gained, rather than for fresh researches, and stressed the need for development of the work arising from the Health of Munition Workers Committee of 1915–17 and the Industrial Fatigue Research Board established in 1918. The report of the Barlow Commission on the distribution of the industrial population of Great Britain and the various inquiries into the success or failure of evacuation schemes provide other examples of the way in which more effective use might be made of existing scientific knowledge in the development of the national welfare, apart from the extension of that knowledge.

Scientific workers have yet to realize that they have a very large responsibility for seeing that much more adequate use is made of the knowledge which they have made available for the community. They must assist much more wholeheartedly in the interpretation of those results to the community, whether to the administrator or to the general public, in order to secure their integration into the general policy and practice of the community. The new Division for the Social and International Relations of Science of the British Association, in the various inquiries it has set going, has already made progress in this field, but much more is required. Men of science should recognize that concern with the social consequences of the application of their discoveries involves attention to the way in which these discoveries are presented to the public, in order to secure as favourable an opportunity as possible for the use of new knowledge for society's weal rather than its woe.

Interpretation or presentation in this sense is inevitably linked up with the question of education, and of securing that the education of every citizen includes at least enough teaching of general science on broad lines to fit him or her to take a place in this world of applied science and to appreciate the scientific outlook. It involves also the use of what may be called rational propaganda—the propagation by reasoned argument of the knowledge and experience and standards of conduct upon which the future of the race, if not of civilization, depends.

Significantly enough, we have come to realize, as was done some twenty-five years ago, that the successful prosecution of the War demands adequate attention to rational propaganda, not merely within our own boundaries but at least in neutral countries also. If it is neglected, or this field left entirely to our enemies, difficulties and misunderstandings may arise, engendering friction or hostility, which may react dangerously on the effectiveness of our policy. We can no more rely on the justice of our cause and the integrity of our ideals, unsupported by wise and fair exposition, to maintain the sympathy of neutrals, than the scientific worker can rely on the statement of his results before a meeting of his fellows to secure the appropriate use of his work in the service of some national interest.

The importance of propaganda as an instrument of foreign policy is well shown by Prof. E. H. Carr in one of the Oxford Pamphlets on World Affairs, in which he not only points out why democratic Governments find it necessary to control and organize opinion if they are not to be at a serious disadvantage in dealing with the Totalitarian States, but also he demonstrates the necessity for some control by the State, however discreetly veiled, over the instruments of propaganda, if the public good is to be served and the community to survive. Even in time of peace, no Government can afford to leave publicity and propaganda in the unguided hands of private interests.

Much of the interest for scientific workers of Prof. Carr's pamphlet is derived from its analysis of the limits and checks on propaganda as well as of its dangers. The tendency of education, itself an instrument of propaganda, whether rational or not, to promote a spirit of independent inquiry, is one of the strongest defences against its wrong use. Further, the more rational the methods by which propaganda is conducted and the more it is in line with the rights and interests not of a section, or class or nation, but of the world community, the more likely it is to be effective.

What has to be recognized is that, although propaganda is an instrument which can be used

wisely as well as unwisely, and has its proper place in the maintenance and advancement of order and culture, it is not a scientific inquiry into truth; a balanced exposition of the evidence for or against his thesis cannot fairly be expected from the propagandist. On this ground alone, it is important that institutions such as Political and Economic Planning or the Royal Institute of International Affairs at Chatham House, which have acquired a deserved reputation for the unprejudiced investigation of social, economic and international matters, and the balanced and unprejudiced presentation and interpretation of their findings to the public, should continue their work and be supported by all those concerned in advancing the standard of education and knowledge in the community; although we may regret, perhaps unjustifiably, the closer association of Chatham House with the Foreign Office, as likely to endanger the reputation of the Institute for the impartial examination of such matters. At least it may be hoped that the criticism at present finding expression as to the mode of exposition of Allied policy and aims in the world generally, or the elaboration and execution of domestic policy in Great Britain, may remind the powers that be that scientific workers recognize responsibilities in such fields which they are eager to discharge.

THE SOCIOLOGY OF PLANNING

Man and Society in an Age of Reconstruction Studies in Modern Social Structure. By Karl Mannheim. With a Bibliographical Guide to the Study of "Modern Society". Translated from the German by Edward Shils. Pp. xxii + 469. (London: Kegan Paul and Co., Ltd., 1940.) 16*s*. 6*d*. net.

PROF. MANNHEIM'S book, we may prophesy, is likely to become the planners' bible, for nowhere else can one find such a complete, up-to-date and well-reasoned analysis of the inevitability of planning, good and bad, and of its techniques. It is, however, more than this rather irreverent comparison would suggest. It is a compendium of modern sociological fact and theory, abundantly documented, woven round the central theme of the planned world's dawning.

Prof. Mannheim was one of the leading sociologists in Germany. With the advent of the Nazi regime, however, he came to Great Britain, and has since been teaching at the London School of Economics. The present volume is a revised and much enlarged edition of an earlier German work published in Holland five years ago. This, as Dr. Mannheim says in his preface, was written when he was "completely under the influence of experiences bred by the disintegrating tendencies of liberal society". He saw how, under certain conditions, the planlessness of the liberal order turned into anarchy. Since then, however, he has been living "in a country where liberal democracy functions almost undisturbed". This enabled him to free himself from his deep-rooted scepticism as to the vitality of democracy in our age. From one aspect, the present volume has become a study, by no means pessimistic, of how planning and order may be combined with the essentials of democracy and freedom.

The formidable extent of the author's learning and background may be gauged by the fact that no fewer than seventy-two pages are taken up with what he calls a "purely personal bibliography", itself elaborately arranged under subjects and subheads.

No reviewer can pretend to give an adequate account of this lengthy and tightly packed book; but a brief summary of the main themes of its six parts will give some idea of its scope.

The first part is a study of the rational and irrational elements in modern social existence. In the mass society of the present day, disastrous tensions develop as a result of the numerous contradictions between the high degree of rationalization in industry and its almost complete absence in politics and ordinary human behaviour. Thus industrial organization becomes a mere façade, behind which irrational force is the *ultima ratio*, both in internal and in foreign politics.

The second study deals with the role of the *élite* in society. Nineteenth century democracy was a 'minority democracy', from whose benefits large sections of the population were formally or virtually excluded. Such a society, however, had one advantage; it permitted the formation of an *élite* which had initiative and could in large measure assume the function of intellectual and cultural leadership. With the rapid transforma-

tion of 'minority democracy' to the present phase of 'mass democracy', *élites* multiply and tend to cancel each other out. Cultural leadership fails, and with it arises a widespread contempt for intellect and the things of the spirit. The obscurantist anti-scientific movement of to-day is a symptom of this phase.

Part three treats of war and dictatorship. The author rightly dismisses the idea of war arising inevitably from human aggressive instincts. The problem is how to canalize our plastic impulses so as to avoid war; like other human problems, it is one of planning and organization. Of extreme interest is his analysis of the Fascist State as a "system of organized insecurity", arising out of the previous disintegrative condition of unorganized insecurity under the guidance of reckless, cynical and unscrupulous groups.

But if insecurity can be organized, why not security? The discussion of this question occupies the last three parts of the book. Security cannot be organized save by conscious, rational planning; organization in human affairs does not just happen. But can thorough-going social planning be reconciled with the basic concepts of our Western civilization? Is it compatible with democracy in any form?—with liberty? We observe the planning techniques developed by the new dictatorships for the total manipulation of their peoples, we see that they are fundamentally undemocratic and destructive of human freedom, and we wonder whether this does not apply to any form of planning.

Mannheim argues cogently not merely that this is not true, but also that planning is essential for any new peaceful development (as opposed to a collapse and a slow and painful rebirth) of free human society. Organization is a mechanism, and, like any mechanism, can be used for good or for evil ends.

The liberal or *laissez-faire* age is nearing its definitive end. Mass or 'structural' unemployment cannot be overcome within the old framework. If not countered, it has a destructive effect on society, leading to mass demands for security and social justice which cannot be met except by broad planning. Already in the democratic countries, even in the New World, this is being undertaken, albeit piecemeal, in the shape of large-scale social services. The old negative type of State, concerned mainly with foreign policy and keeping the ring at home, is here giving place to what we may call the Social Service State. The planned all-round development of the Social Service State is the only alternative to the planned Totalitarian Power State—or to chaos.

It would take too long to follow Mannheim through his thorough discussion of the means by which the planned Social Service State may be nursed from its present embryonic condition into full and efficient being. One or two points, however, may be mentioned. An enlarged bureaucracy is a necessary instrument of any planned society; he stresses the need for not allowing this to become dominant or out of hand. One safeguard against this is the presence of a strong unofficial *élite*; this can only be maintained in a modern mass-society by an enlarged educational system with new content and aims. Here is to be found at least a partial answer to the perennial question: "Who plans the planners"? The answer clearly is, that no one attempts such a megalomaniac task; on the contrary, planning is a continuous and deliberate process, which demands experiment and discussion, check and countercheck. The intellectual *élite*, informed public opinion, the bureaucracy and the Government can act as checks and counterchecks on each other to ensure a balanced growth of this sort.

Finally, in an interesting section, Mannheim points out that liberty is never absolute, but always relative to the social system, and that liberty in a planned society will differ from liberty as we have become accustomed to it in a *laissez-faire* society. It is the correlative of responsibility, and a free planned society can only exist on the basis of many new responsibilities.

No single book can expect to cover this vast field fully. It seems clear that the next step must be a more concrete analysis of the problem in relation to the differences between various nations and to the particular problems before them severally and jointly. It is only a rough first approximation to speak of the Western democratic countries: France, for example, differs radically from Great Britain in many important respects of social structure and outlook, and both from the United States. Again, the relation of the various metropolitan powers to the world's backward colonial areas constitutes a special problem of its own, which the author does not touch upon.

However, for any such more detailed or more concrete studies Dr. Mannheim's book will be an indispensable basis. Metamorphosis in animals is a somewhat cataclysmic process of development. It is no less so in the development of societies. What we are accustomed to call civilization is in the midst of a metamorphosis of which the present war is a symptom. "Man and Society in an Age of Reconstruction" is one of the very few works to deal comprehensively and on an adequate basis of scholarship with this alarming but in the long run hopeful phase of human development.

JULIAN HUXLEY.

PRACTICAL PHYSICAL CHEMISTRY

Physico-Chemical Methods

By Dr. Joseph Reilly and Prof. William Norman Rae. Third edition. Vol. 1: Measurement and Manipulation. Pp. xv+686. Vol. 2: Practical Measurements. Pp. ix+580. (London: Methuen and Co., Ltd., 1940.) 84*s*. net.

PHYSICAL chemists in Great Britain have in the past usually looked to Germany for the provision of those monumental text-books which treat in exhaustive detail and with characteristic thoroughness the various branches of the subject. But in recent years there have been welcome signs that this position will not continue. The number of British texts on that increasing borderland between chemistry and physics is the best evidence that physical chemistry is at last beginning to take an independent and, it is hoped, original outlook on the matter. The two volumes under review form another addition to the ever-growing list.

"Physico-Chemical Methods" has already passed through two editions, and it was inevitable that a third edition must expand, until now the book has been split into two large volumes. The writers of such a comprehensive text are faced with difficulties unknown to the author of a specialized monograph. They cannot themselves be experimentally familiar with the whole field. Consequently they must invite collaborators to write much of the text if this is to be truly representative; at the same time, the whole must be homogeneous. Another difficulty arises in the following way. Much of the apparatus used in physical chemistry has been elaborated by commercial undertakings to such an extent that it is impossible for an ordinary laboratory to attempt to construct it. In a practical text-book, therefore, all that remains to be done is to describe how the apparatus is used; in view of the diversity of designs the authors' task is made all the more difficult. In the present book there is a judicious balance kept between these conflicting claims.

The two volumes are rather arbitrarily divided into measurement and manipulation (Vol. 1) and physical properties (Vol. 2). They are, of course, closely complementary. Vol. 1 opens, as usual, with chapters on measurements and calculations. Then follows a very short chapter on phase rule practice. Admittedly the principles of obtaining phase rule diagrams in sufficiently simple systems are easy enough, but the practice is often extremely difficult. The brevity of this chapter is compensated later on by a full discussion of evaporation and distillation. Next follow a number of chapters on apparatus and laboratory technique. Here there are some excellent up-to-date sections; for example, that dealing with pumps, but perhaps glass working might have made way for more physico-chemical technique.

There is, too, a chapter on high-pressure technique by an expert in the field. The question does arise, however, whether a person not familiar with the technique would be justified on embarking on a programme involving its use, after perusing this chapter. This does not in the least reflect on the merits of the chapter, which forms an excellent introduction to the field—more akin to precision engineering than to chemistry. In the chapters on thermometry and thermochemistry, the thermopile might have been given more prominence, as it is being increasingly used; similarly, there is no description of the disappearing filament pyrometer. Mention of the more recent types of adiabatic calorimeter would also have been welcome.

All the classical practical physical chemistry is described at length in the second volume. It is gratifying to find, too, an account of the technique for dealing with the properties and reactions of monolayers. As might be anticipated, vaporization and fractionation are dealt with in authoritative detail, the recent work on molecular stills taking due prominence in this section. Under the heading solids, mention is made of flotation; filtration, too, gets its share of space, but it is doubtful whether a description should be included of large-scale filter presses. There is also a description of the air-blown ultracentrifuge. No doubt in the next edition there will be much to be added to this section when the instrument is more fully developed.

The optical methods described are largely those of classical physical chemistry, but a supplementary volume is promised to bring this part thoroughly up to date. Once again the problem of defining the bounds of a topic arises. Infra-red, Raman and X-ray methods are mentioned. This is really all that can be done. These subjects are highly specialized, and although it is desirable that an undergraduate should have some slight experimental acquaintance with them, a detailed knowledge is not necessary.

The chapter on thermionic valves is absolutely essential, and might well be considerably extended in order that those not very familiar with the subject might be shown how to utilize with

confidence these extraordinarily useful devices. The dielectric behaviour of substances is described in sufficient detail. Electrochemistry gets its quota of pages, and the useful polarograph is described in detail. The final chapter on radioactivity is brief. Perhaps here, too, the right line to take would have been to deal with natural and artificial radioactive indicators, which are becoming of ever-increasing service in all the many branches of chemistry.

As will have been gathered from these remarks, this book is of so comprehensive a scope that it must find a place on the bookshelves not only of physical chemists, but also of those who make the slightest contact with this rather ill-defined branch of science. H. W. MELVILLE.

HEALTH AND OCCUPATION

Health in Relation to Occupation

By Dr. H. M. Vernon. (Oxford Medical Publications.) Pp. viii + 355. (London: Oxford University Press, 1939.) 15*s*.

THIS book contains a valuable summary of existing knowledge on the subject of which it treats, and gives pointers to many directions in which new information is required.

Dr. Vernon investigates the relative importance of the three main factors—heredity, occupation, and social environment—on which the health of the community depends, and comes to the conclusion that occupation, though important, is of far less account in controlling health than the other two factors.

Any attempt to isolate and investigate the three factors is found to be extremely difficult, since they are almost inextricably interlocked, variation in any one factor having as a rule an indirect effect on the others. For example, the direct effects of heredity on health are shown to be inconsiderable, while its indirect effects, operating through the strongly inherited faculty of intelligence, are important; for example, the intelligent man is usually able to avoid on his own initiative many of the occupational risks to which he is exposed, while he also tends to rise to a higher grade of occupation which, being better paid, is on the whole less likely to induce ill-health.

The relative importance of heredity and environment in their effects both on health and intelligence is discussed. Researches into the characteristics of various classes of twins are described, and show that the 'nature *v.* nurture' controversy is still an open one, some investigators attributing to heredity only one half of the difference in *I.Q.* of children of the same parents reared together, others, after a study of numerous pairs of twins, making heredity three to five times more significant than environment. Perhaps it is true, as is asserted by one group of investigators of nineteen cases of identical twins reared apart, that "for twins reared together most of the differences between members of a pair may be due to the nature factor; whereas for twins reared under strikingly different environments the nurture factors will have a relatively greater influence".

Of the environmental factors which influence health, nutrition is shown to be by far the most important. Adequate nutrition is largely, though not entirely, dependent on adequate wages, which in its turn is dependent on economic causes of a controversial and complex nature. The writer reviews the problem of the nutritional standards necessary at all ages and under varying conditions of occupation; and shows that many 'protective' foods which should be included in a diet are beyond the resources of the worst paid members of the community. The ill effects of inadequate nutrition, particularly on expectant and nursing mothers, are described, and the beneficial results of certain controlled experiments examined.

In a survey of the present standard of living we find that recent investigations into the family income of working-class homes in London show that a third of them failed to reach the standard laid down by the author, while many were far below it. Wages form, in fact, the fundamental basis on which the adequacy of social environment depends; and Dr. Vernon states his belief that the greatest single factor for the improvement of the nation's health is the provision of an adequate income for all members of society.

Coming to the occupational factor, we find that, while a good deal is known about the effect of occupational conditions on mortality, we have little exact information as to their influence on health and sickness. The causes and effects of all known occupational diseases, as well as of accidents and psychological disorders, are discussed, and remedial measures suggested. But we are led to the conclusion that occupation acts on health more in an indirect manner by determining wages, and therefore social environment, than by any direct action.

Allowing for the effects of intelligence in increasing the importance of the hereditary factor, Dr. Vernon hazards the suggestion that the relative importance of the three factors may be estimated as: heredity, 40 per cent; occupation (direct effects), 10–20 per cent; and social environment, 40–50 per cent. He gives these figures as provisional, and as a challenge to criticism and a stimulus to the search for further much-needed information.

In his concluding chapter the writer discusses possible curative measures for the improvement of social conditions, and refers to plans which have been suggested by various authorities for a thorough-going revision of the health services of the nation.

MAY SMITH.

INFORMATION AND PROGRESS IN ENGINEERING AND INDUSTRY

Records and Research in Engineering and Indus rial Science

A Guide to the Production, Extraction, Integrating, Storekeeping, Circulation and Translation of Technical Knowledge. By Dr. J. Edwin Holmstrom. Pp. xii+302. (London: Chapman and Hall, Ltd., 1940.) 15*s*. net.

THE present work is a treatise on the collection and selection of information for use in the development of engineering and manufacture. Since progress in science and industry consists in the application of knowledge previously acquired, the problem of making this knowledge available in the fullest degree is a study of fundamental importance. Yet, for some reason, difficult to imagine, the laboratory worker, reading a gauge or shaking and looking at a test tube, enjoys support and prestige denied to the documentalist, engaged in processing the raw material of knowledge so obtained. Through such neglect, untold sums are wasted annually in working out engineering projects, developing inventions and conducting experimental researches which might have been saved altogether or begun from a more advanced starting point if the technique of finding out what other workers had already placed on record had been properly understood. Haphazard reading of the current issues of a few technical periodicals in moderation is not a waste of time. But, when we realize the thousands of journals, any volume of which, past or current, might contain information on a single subject, the method is seen to be essentially inefficient as a means of gathering specific information. Valuable time must not be frittered away in reading documents which are not the best for the immediate purpose.

The task of documentation is to provide a subject index that will enable us to select at will, from the millions of scientific and technical writings poured out, the particular documents relative to a specific inquiry. A single adventure in modern industry may depend for its realization on the application of the widest range of scientific and technical knowledge. Documentation needs to be organized from the point of view of science as a whole, instead of being worked in watertight compartments as at present, with a corresponding loss of efficiency.

Following useful chapters, describing in detail the present fortuitous concourse of research institutions, and the heterogeneous aggregate of "collative organisations", as the author terms them, the work passes on to discuss, in two important chapters, the methods of gathering ideas from technical literature and of sorting and integrating these ideas. The writer shows how the co-ordination of the mass of current unrelated abstracting and indexing work is being achieved gradually by the extension of the use of a standard method of classifying references. This method is the Universal Decimal Classification. Incidentally, it may be remarked that between a third and a half of the different items in scientific and technical literature indexed are now being classified by the standard method. In the Science Library at South Kensington, all references and abstracts classified in this way are cut up, mounted on cards and amalgamated in a central index of two and a half million cards, which is growing at the rate of from 120,000 to 150,000 cards annually. From this index, supplemented with a general collection of bibliographies and lists of references on all branches of science, comprehensive bibliographies on sufficiently restricted subjects of inquiry are prepared, free of charge, by an expert staff.

The book includes a description of the Kaiser System of indexing, for non-co-operative purposes, and gives due weight to economic and commercial aspects. The work appears at an opportune time, when the achievement of the greatest efficiency in documentation is essential. As an analysis of the subject and a comprehensive guide to sources of information, the volume should be in the hands of the business man, engineer, abstractor, indexer, and librarian alike.

S. C. BRADFORD.

JUNGLE PEOPLE OF TRAVANCORE

The Travancore Tribes and Castes

By L. A. Krishna Iyer. Vol. 2. Pp. liv + 344 + 86 plates. (Trivandrum : Government Press, 1939.)

MR. KRISHNA IYER is much to be congratulated on his lucid description of the history, customs and ceremonies of the tribes of Travancore. The careful classification of subjects makes the book of practical reference. In every way he tries to tell us the reasons and underlying ideas for the behaviour of these jungle people, all of which makes for greater interest. Each tribe section is preceded by a map showing the geographical distribution, an original and helpful arrangement. Many photographs of groups and heads aid description, and at the end of the book notes on index and stature are given. The volume is enhanced and framed as it were by an introduction written by Baron von Eickstedt, a masterly exposition of the development of Indian anthropology, and how the great Indian races have been studied, named and classified.

The ruling house of Travancore, seconded by Cochin, takes more interest in its aboriginals than any other State. They are treated as a 'backwards community' and helped in every possible way ; if necessary by giving land and establishing small colonies. Travancore was our first ally to establish law and order in India in the days of Tipoo Sultan, and it is interesting to note that in 1812, the Maharani of Travancore abolished slavery entirely in her realm, anticipating the British Government in this much-needed reform. In the chapter on the Pulayas (who were originally slaves and look it) there is most interesting reading on this subject (pp. 121–129).

The historic and amazing proclamation by the present Maharaja on the right of temple entry (1936) astonished all India. It will go down to posterity as a charter of religious liberty, says Mr. Krishna Iyer (p. 129).

The author begins this volume with the Muthuvans, a most intriguing people with an aquiline nose peculiar to them. The tribe are accomplished hill men though they came from the plains. The region which is now their habitat has the most entrancing scenery of all Travancore. Their method of cultivation can be seen from any hill top, for they make clearings in the jungle like all primitives, believing that mother earth should not be slaughtered with a plough. When they have made seven 'kudis' they go back to No. 1. Their women are never or rarely seen. I believe I was the first European to be allowed to meet some and photograph them. From shyness or custom they hide in the jungle at the approach of a stranger.

There are many interesting pages about their form of worship, which is a complete mixture of Hinduism and animism (pp. 28–33). I was taken to see just such a temple to Subramani as the one described. The Muthuvans worship the sun both morning and evening. "O God we live in the jungle. We are ignorant of everything. Protect us". It is probable that this worship may at one time have formed a prominent part of their religion. Their prayers are always naïve and direct : "O God save us from elephants, pigs and panthers". "O God, my cultivation is being ruined for want of rain. It would be a good thing if it rained". There is much charm, too, in their folk-lore : "Earthquake is believed to be caused when the goddess removes the earth from one shoulder to the other because of its weight".

Palayans and Uralies are only to be found around Periyar Lake, another beauty spot in Travancore (pp. 68 and 223). Here big game can be hunted as well as tribes, for there is a five-mile preserve round the Lake. Bison and elephant come there regularly to drink ; a tiger walked across my track while I was visiting a Palayan village. These isolated groups of people are extraordinarily brave. The Palayans welcomed me in a most original way ; they had built a bench with a decorated canopy over it to give me shade, and their manners were charming.

Nothing more picturesque can be imagined than an Uralie hamlet ; they build most of their huts in the trees, for like the Muthuvans they live in daily terror of elephant, which trample and eat up their scanty crop. Shooting wild elephant is made difficult in Travancore, for the legend runs that when elephant disappear the line of Maharajas will also cease.

The Uralie marriage laws are unique. "No man can have a wife unless he has a sister whom he can give in exchange." So far as I could discover, the unfortunate sister is left at the bride's house and has to act as daughter there (p. 229).

Mr. Krishna Iyer tells us much that is of interest about the Nayadis, a remnant of an ancient people (p. 49). Those of Cochin State are short of stature and miserable looking, and they spend their day in begging in the bazaars. Possibly even these will be reformed and civilized by a patient Government. A reform of this kind will cause no sorrow, but anything that tends to change the native dress and customs of these ancient and wonderful tribes saddens me, and I look at the photograph of the Thanta-Pulayas in their leaf garments on p. 123 with regret.

MARGUERITE MILWARD.

TREATMENT OF ABATTOIR WASTES

By J. H. CODLING, M.B.E.,

CITY OF BIRMINGHAM SALVAGE DEPARTMENT

THE products obtained from the treatment of abattoir wastes are progressively assuming greater importance in our war-time national economy. For many years several of our larger municipalities have recognized the potential value of these wastes and have acted accordingly, but there are still many authorities which even now ignore the important contribution which these wastes can be made to pay to our war effort. The reason in many cases may lie in the fact that apparently the amount of such waste is too small to warrant the installation of plant for its treatment; perhaps in other cases it is imagined that insuperable technical difficulties will beset the path.

NATURE AND CLASSES OF RAW MATERIALS

The slaughterhouse wastes usually available for treatment by municipal authorities consist of condemned meat, and the viscera consisting of the intestines, stomachs and other organs of slaughtered beasts. To this may be added, whilst not strictly abattoir waste, such materials as fish and fish offal waste. From such crude raw materials, after suitable processing, there are produced feeding meals for pigs and poultry, organic fertilizers of first-class quality, and incidental to the process there results the reclamation of the valuable fat content of the tissues which to-day is of such importance in the manufacture of explosives. Household bones recovered from house refuse may similarly be treated for the production of a fertilizer or a feeding bone meal and the recovery of bone fat.

Referring to my own experience in Birmingham, where a process known as 'Dry Rendering' is in operation, and to which the ensuing facts relate, we treat here about 5,000 tons annually of such raw materials as are included above, and produce therefrom about 1,000 tons of fertilizers or feeding stuffs and about 200 tons of fat. As glue is a material of such great importance in aeroplane manufacture, all the bones recovered from the house refuse of Birmingham are sold to firms which specialize in glue recovery; these firms simultaneously recover the grease, and the meal residue is a bone fertilizer. Otherwise, if treated, as they can be, through the ordinary process of rendering, the glue would not be recovered but left in the meal as the protein content, in which form, of course, it still serves a valuable purpose used either as a feeding meal or fertilizer. If glue recovery were desired, it would mean setting up special digestors and other plant to deal with what is, after all, only a relatively small proportion of our raw material.

DERIVED PRODUCTS

Condemned meat is a valuable raw material, yielding as it does a valuable meat meal for feeding purposes, and fat. The carcasses are treated as received, the only preliminary treatment being the cutting up into suitable sizes for feeding into the machines employed in their processing. In round figures this material yields about 25 per cent of feeding meal and about 15 per cent fat. Again in round figures, the feeding meal, which is dried down to about 10 per cent moisture, shows on analysis about 55 per cent protein, 10 per cent oil and 9 per cent phosphoric acid. It is obvious, therefore, that this product is a highly concentrated food; it is sweet and palatable, completely sterilized, and is worth to-day about £15 per ton.

Slaughterhouse offals, consisting of ropes (intestines), farthings (stomachs), paunches and various other organs are all treated together with their ingesta for the production of a fertilizer, and the recovery of their all valuable gut tallow. Incidentally, this tallow is coloured green, due to the chlorophyll present in the food which the beast has eaten, but it is none the worse for this as the fat refiner easily bleaches it. About 20 per cent yield of fertilizer is obtained, which apart from the value displayed by its analysis has the further advantage of a high content of humus-forming material; also about 5 per cent fat is obtained. The fertilizer, dried down to about 10 per cent moisture, shows between 5 and 6 per cent nitrogen and about 3 per cent phosphoric acid; it sells at about £5 per ton. In the Birmingham process we have found it better to let the white fat recovered from condemned meat run to the same tank as the green fat from the slaughterhouse offal rather than make two fat products, although this can be done if desired.

Fish, if white, is worth treating separately from the oily fish, and can then be used as a fish feeding meal, whilst usually the product of the oily fish, after oil extraction or even without, is used as a fish manure. If the respective quantities available do not warrant separate treatment, then the whole of the fish waste is converted into a fertilizer. About 25 per cent recovery is effected and the manure will analyse 8 per cent nitrogen and 8 per cent phosphoric acid ; its value to-day is between £10 and £11 per ton.

In the case of small towns the initial segregation of the raw material into such classes as the above may not be warranted owing to the small quantities respectively available. Under such conditions the procedure of treating the whole of the raw material together for the production of fertilizer and fat is successfully practised.

PLANT AND PROCESSING

The raw material to be dealt with contains some 70–80 per cent moisture, and it is the purpose of the process to reduce this to about 10 per cent, in which condition, suitably stored, the resultant meal will keep for an indefinite period. In addition it is obviously desirable to remove as much grease as possible from the tissues. The type of plant which I consider most suitable for the use of municipalities is that known as Dry Rendering, which is the one I propose to describe.

The drying process is effected in a cylindrical steam-jacketed vessel lying horizontally (Fig. 1). This vessel is fitted with revolving arms driven by a motor which keep the contents of the vessel agitated to assist the free emission of the water vapour during the drying process. A charging hopper for the introduction of the raw material is fitted to the top and a discharging door for the removal of the finished product is fitted to one end. These machines are built in various sizes and designed to suit whatever steam pressure it is desired to employ in the jacket.

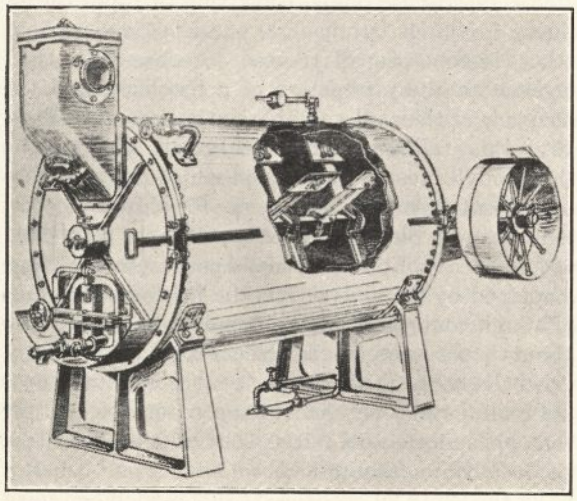

Fig. 1

DRAWING OF DRYER WITH SIDE CUT AWAY TO SHOW AGITATOR INSIDE AND STEAM JACKET. CHARGING HOPPER AND DISCHARGING DOOR ARE AT FRONT OF MACHINE.

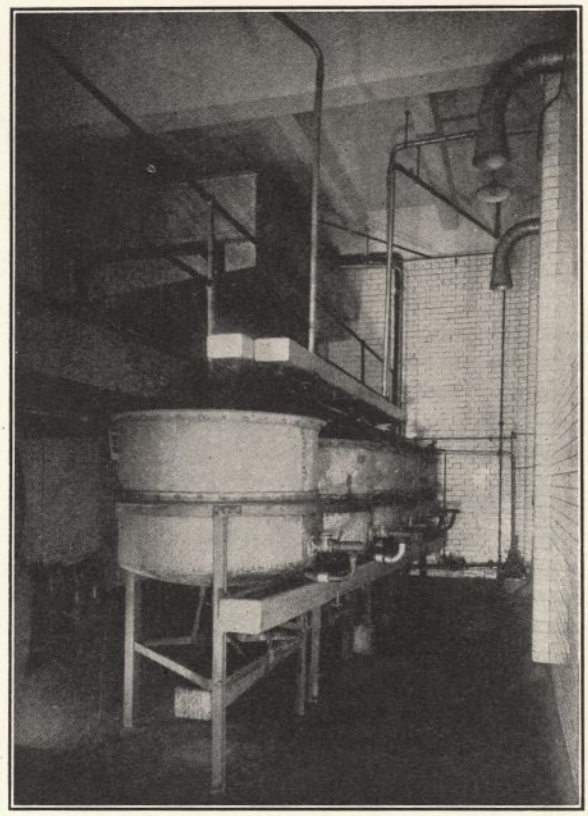

Fig. 2

FAT-CLARIFYING TANKS. FAT EXTRACTORS ON FLOOR ABOVE DISCHARGE INTO THESE TANKS THROUGH THE VERTICAL PIPES.

The fat extraction is usually effected at the conclusion of the drying process by subjecting the hot greasy product from the dryer to pressure. The machine employed is known as a Turbine Centrifugal Fat Extractor. It consists of an outer steel cylindrical case containing a rotor which is caused to revolve by a steam turbine in the base of the machine. A cylindrical perforated steel cage, fitted with a filter cloth, is loaded with the material to be fat extracted and then lowered into the rotor by a hoist. The lid of the machine is closed and steam turned on, which causes the rotor to revolve. The steel cage and its contents are thus caused to revolve at 650 r.p.m., and this revolution gives rise to centrifugal force which results in the contents of the cage being pressed up tightly against its side. The great pressure exerted squeezes out the fat,

which passes through the filter cloth—the latter retaining the solids—and so to the fat purifying tank. This fat extraction usually takes forty minutes for a charge of 4–5 cwt. of material, and properly effected will leave only some 10 per cent fat in the finished product. After fat extraction the machine is stopped, the cage removed and its fat-extracted contents tipped out. This product is cooled and then ground down through a disintegrator into a uniform finely divided meal, in which form it is bagged and sold. The fat recovered passes by pipe-line from the extractor to a fat purifying tank which is fitted with a steam coil. Here water is added and brought to the boiling point by the steam coil, whilst the fat is agitated. After this washing, the contents of the warm tank are allowed to settle. The impurities sink to the bottom and are finally run off with the wash water, after which the fat is barrelled ready for sale (Fig. 2).

Briefly, therefore, the procedure is to charge a dryer with the appropriate quantity of raw material. The machine is closed, steam turned into the jacket and the agitator set in motion. After 5–6 hours the machine is stopped and its contents discharged. If oil extraction is to be undertaken, they are discharged into a suitable tank from which the fat extractor cage is filled. The latter is placed in the fat extractor and set in revolution and subjected to centrifugal pressure for forty minutes. The machine is stopped, the cage removed, and its contents discharged; they are then cooled, ground down and bagged. The extracted oil is clarified and barrelled, as already described.

In the confines of this brief article no more than an outline of the process can be attempted. In passing, however, mention should certainly be made of a rather more elaborate dryer, known as the Iwel Laabs, which is a machine possessing certain advantages not the least of which is that it definitely secures complete sterilization of the product, whilst its operation is but little less simple than its prototype described above.

Control of Foul Vapours

It is obvious from the very fact that the raw material is 'waste' that much of it will be in a more or less decomposed state, and the vaporous products of this decomposition can be decidedly unpleasant. During the drying operation these vapours are driven off with the water vapour, and unless precautions are taken an atmospheric nuisance will arise. Fortunately the bulk of these vapours are soluble in water, so that the vapours emitted from the dryer are passed into a condenser where they meet a spray of water which affects their solution, and this is run off to the sewer. The uncondensable portion of the vapours will, however, pass out of the condenser, and these vapours must be carried to some point and destroyed. This can be effected by passing them into a region where a continuous and uniform temperature of 1400°–1500° F. can be maintained.

But the more effective modern method is to subject these uncondensable vapours to the action of chlorine, whereby they are completely oxidized and rendered odourless. The apparatus to effect this desirable metamorphosis is cheap initially and in upkeep, and low on its operation charges. The chlorine is purchased as a liquid gas in cylinders and connected to suitable apparatus known as a Chloronome, which measures out and applies the correct dosage of chlorine to the vapours being treated. As the uncondensable vapours leave the condenser the correct dose of chlorine is injected into the pipe conveying them, and means adopted for securing intimate admixture. The result may be discharged direct to atmosphere in an odourless condition. In the plant under my control, four machines simultaneously emitting their maximum quantity of vapour require only 1/10 lb. of chlorine per hour for its deodorization. The use of chlorine gas implies corrosion of the metals with which it comes in contact. Suitable precautions, such as painting all exposed surfaces with heavy coats of bitumen, must therefore be adopted.

Plant Required

The amount of plant required is, of course, intimately related to the amount of material it is proposed to treat and the size of the machines it is convenient to purchase. Hence no advice can be given on this matter. The only guidance one can provide is that a small 7 ft. dryer, two small turbine extractors or one large one, a fat clarifying tank and a small disintegrator should be capable of treating 10 tons of raw material per week working a twelve-hour day. Complete guidance on this matter can, however, always be secured by laying the full facts before manufacturers of the plant, such as the Industrial Waste Eliminators, Ltd., of London.

I know that some authorities have been deterred from undertaking this work, due to the fact that they consider there is insufficient raw material available in their area to warrant the installation of the necessary plant. I am informed, however, that a plant laid down to treat only three tons of raw material per week is making a satisfactory return. Generally, this amount can be easily exceeded, especially if a few small neighbouring authorities co-operate in the disposal of this waste.

POWER AND STEAM REQUIREMENTS

The power and steam requirements of the plant employed are again regulated by its size and the amount of work undertaken. Obviously, however, such a plant can make very effective use of the steam produced, say at a refuse disposal works, from the burning of house refuse.

As some guidance in the matter, a moderate-sized plant would require the following power supply :

Dryers. 4–5 units per 1,000 lb. of raw material treated.

Disintegrator. About 20 units per ton per hour.

The steam consumption of the same plant would approximate to the following :

Dryers. 870 lb. per 1,000 lb. raw material treated.

Vacuum pump. 85 lb. per 1,000 lb. raw material treated.

Fat extractor. 140 lb. per 1,000 lb. raw material treated.

Fat clarification. 500 lb. per ton of fat clarified.

The adequate supply of feeding stuffs and fertilizers is rapidly becoming an increasingly important factor of our national economy and it behoves everyone in a position to do so, to examine the possibilities of what contribution can be made on the lines indicated above. Even if such raw materials as specified are unobtainable, there is still the problem of converting kitchen wastes into dried pig and poultry meals, which can be solved on similar lines and with the same plant, except that fat extraction will be unnecessary.

GEOLOGY AND EARLY MAN: I

BY T. T. PATERSON,

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THE postulates summarized in this, and Part II, are the results of work on five expeditions, two to the Arctic with the Wordie Arctic Expeditions, to India and the Himalaya (Yale-Cambridge Expedition 1935), to East Africa, and to Northern Europe. I was financially assisted by Trinity College, Cambridge, the Royal Society, the Percy Sladen Fund Trustees, the Royal Geographical Society and Mr. L. C. G. Clarke, and have been in receipt of a senior studentship from the Commissioners of the 1851 Exhibition.

A SYSTEM OF PLEISTOCENE CORRELATION

The correlation of the various phases of the Pleistocene throughout the world has not been in any way assisted by the obscurities attached to the interpretation of 'pluvial periods' within the non-glaciated regions. Nor has the palæontologist been able to supply enough fossils and variations of types which could give the necessary detail, one point only being of outstanding value, the palæontologist's view that the commencement of the Pleistocene is marked by the appearance of Elephas, Equus, and bison, or any one of these. This definition of Haug was adopted by James Geikie in his, the first, Pleistocene correlation system, and is followed here, as well as Geikie's simple nomenclature for glacial periods. It is deplorable that Geikie's work (which not only takes priority but also has not been seriously challenged), has been discarded in favour of a nomenclature having purely a local application to the Northern Alps. The chief sinners in this respect have been prehistorians, but lately the disease has spread among geologists and has been furthered by writings which not only show complete lack of appreciation of the works of the master but also introduce new Continental expressions into our nomenclature where plain English has well sufficed before.

A new approach is necessary, and it seems that a solution lies in the recognition of a world-wide system of three easily recognizable major cycles of sedimentation, each beginning with a coarse and ending with a fine facies. The beginning of the first seems to coincide nearly uniformly with the known earliest occurrences of the Pleistocene faunal group of Haug. These cycles are here named the Lower, Middle and Upper Pleistocene. The accompanying table illustrates the system and is self-explanatory. Each major cycle shows a subdivision into subsidiary cycles when a rejuvenation of sedimentation marks out the Lower into two phases l_1 and l_2, the Middle into m_1 and m_2, and the Upper into u_1, u_2 and u_3. Within the glaciated regions the commencements of each of the major cycles coincide with Geikie's first three cold periods, the fourth cold period marks the beginning of phase u_3, and the fifth the end of the Pleistocene.*

* Correction :—Gamblian (East Africa) should be age u_3, and Pagan Silt (Burma) should be age u_1.

STRATIGRAPHY	GEIKIE SYSTEM (WARM / COLD)	EROSION / AGGRADATION	TERRACES	CHINA	JAVA	BURMA	HIMALAYA	SOUTH INDIA	SINKIANG
UPPER U_3	5		T_5	Djalai Nor Panchiao		T_5 5 T_4 gravel	T_5 5 T_4 gravel 4	T_4	
UPPER U_2	4		T_4	? Mongolian sands Loess	? Solo Terraces	Pagan silt T_3 gravel	Potwar T_3 gravel	silt T_3 basal gravel	loessic loam T_3 gravel
UPPER U_1	3	EARTH MOVEMENT	T_3	Loess dry Malan Chinghsui	Ngandong	red earth dry gravel T_2	Potwar aeolian silt gravel T_2 M 3	silt gravel T_2	loess gravel T_2 M
MIDDLE M_2			T_2	dry red loams	Trinil	dry T_1	silts T_1	little sand T_1	sand T_1
MIDDLE M_1	2	EARTH MOVEMENT	T_1 T_D Highest Deposition Surface	Choukoutien	Trinil Djetis	lateritic soil T_D coarse boulder gravels	T_D Boulder Conglomerate M 2	T_D redeposited Laterite Laterite	sandstone Bora series conglomerate
LOWER L_2				M Upper Sanmen	M ? Kali Glagah	M Upper Irrawaddy Series	M Pinjaur [Karewa]	M ?	M Kokyar series
LOWER L_1	1			[Nihowan—Yunnan] Lower Sanmen Fenho	?		Tatrot 1	?	

	VAAL BASIN	EAST AFRICA	NILE VALLEY	N. and E. GERMANY	NORTHERN ALPS	NORTHERN FRANCE	THAMES VALLEY	EAST ANGLIA	NORTH AMERICA
UPPER U_3	E Schoolplaats dry	E gravels 30 ft. T.	E 10-15 ft. Terrace	E—T_6 Weichsel—5 E—T_5 Warthe—4	Y Loess II Wurm II—5 E Wurm I—4	Recent Loess E Solifluxions 8 + 9	Lower Flood Plain T_4	T_5 Gravel + Loam T_4 Upper B.C.—4	Peorian Loess Iowan—4
UPPER U_2	E Youngest gravels dry	E O—Horizon dry " flats " gravels	E 30 ft. Terrace Sediments	Loess E—T_4	E Young Loess I	"F_6" Recent Loess I E Solifluxion 7	Crayford T_3 Solifluxion	Loam—Hoxne T_3 Solifluxion	Loveland Loess
UPPER U_1	Sands E Younger gravels III	N—Horizon dry false-bedded sands Gamblian M	50 ft. Terrace sediments E	Loess Gravels E—T_2+T_3 Saale—3	Old Loess E Old Loess—Kiss—3	Old Loess E Solifluxions 5 + 6	Taplow T_2 main coombe rock	Loam—Hoxne Thick gravels T_2 M Middle B.C.—3	Illinoian —3
MIDDLE M_2	Sands E Younger gravels II	dry M—Horizon	E 100 ft. Terrace sediments	Loess E—T_1	Loess E	"F_5" Loess E Solifluxion 4	Middle Barnfield T_1 Clacton	Unevenbedded S. Loam T_1 Solifluxion	Yarmouth
MIDDLE M_1	Sands E Younger gravels I	Silts Oldowan beds Sands Gravel boulder gravel M	150 ft. Terrace Depositional surface	Gravels E— Elster—2	Silts Jungerer Deckenschotter ? Mauer intraglacial E Mindel—2 M	"F_3" Gravels E Solifluxions 2 + 3	Lower Barnfield Gravels M	Barnham Sands T_D Thick gravels M Lower B.C.—2	Kansan —2
LOWER L_2	dry Kalahari sands E Older gravels	Kaiso		E—" Preglacial " III	Silts E	?	High Terraces and Clay-with-flints	Cromer series	Aftonian
LOWER L_1		Kisegi		E—" Preglacial " IV	Alterer Deckenschotter Gunz—1	?		Crag series 1	Nebraskan —1

E = erosion. Detached Arabic numerals to right of columns represent glaciations, Geikie nomenclature. M = earth movement.

A SYSTEM OF PLEISTOCENE CORRELATION.

Within the non-glaciated regions, the beginning of each of the seven phases is marked by an erosional disconformity which, if it is thought essential, could be interpreted as evidence for a 'pluvial period'. The major periods of aggradation (see curve) follow on those erosional periods coincident with glacial advance, and end in stages of stability prior to the rejuvenations of erosion marking the next, subsidiary, phases. The first three erosional periods can only be observed as stratigraphical disconformities in section, but the last five are very widely met with as terrace escarpments. The method adopted here of defining terrace forms by the erosional scarps which isolate them has been found more satisfactory and less liable to misinterpretation than classification on terrace components which are often composite. The five terrace escarpments are named T_1 to T_5 and the top surface of deposition—aggradation gravels of m_1 succeeding the big second glaciation—T_D.

The first two cycles end with episodes of aridity which, in the tropical regions, may occupy almost the whole of the 'rejuvenation subsidiary' phases, l_2 and m_2. Dry episodes occur also at the ends of phases u_1 and u_2. In periglacial regions such arid episodes are represented by loessic deposits, in sub-tropical parts by æolian silts, and in tropical regions by bands of rock, shattered by insolation and brought to level by solifluxion during the short, but intense rainy seasons.

Under the heading 'Geikie system' the curve represents climatic change within the glaciated regions, the middle interrupted line indicating temperate climate, and curves to the left and right indicating warm and cold respectively, the depths of the glacial maxima, 1 to 5, showing ice sheet extensions rather than actual climatic extremes, for the fourth ice advance was the coldest. The repetitive cyclic character of the curves of climatic change and sedimentation variation will be seen to correspond. So it seems that the greatest ice extension and locking-up of water coincided with the greatest erosional activity in most parts of the Old World, that is, with increase in precipitation there. Therefore the factor of eustatic variation must be taken into account as important when considering the relations of base level change and isostatic compensation for ice load. The question of precipitational change will be looked into in the next section.

One further point emerges. At the beginning of both the Middle and Upper Pleistocene, there was earth movement of some kind in all except the most stable crustal blocks. In an orogenic region there may have been even over-folding and thrusting as well as uplift. For example, in the foothills of the Himalaya the Lower Pleistocene (Upper Siwaliks) were thrusted, and uplift of 6,000 ft. has taken place since the beginning of Middle Pleistocene times. At the opening of the Upper Pleistocene there was no folding, but warping began and has gone on even to the present day. In a region of rifting, faulting occurred accompanied by volcanic activity, as for example in the Rift Valley in East Africa. In the stable areas of South India and South Africa there is little evidence for earth movement, but in the Scandinavian and Canadian shield areas there are indications of vertical crustal deformation. In south Britain this was of the order of several hundred feet where, also, the London Basin was further warped on its northern flank. In the eastern Asiatic periphery and in the Rift Valley the tectonic activity of the beginning of Middle Pleistocene times extended the erosional disconformity into unconformity.

The faunal variations cannot be given here owing to lack of space, but in general it can be said that the Villefranchian type of assemblage is confined to the Lower Pleistocene, with some Pliocene survivals into phase m_1 as at Mauer and in China. By phase m_2 Pliocene survivals have gone, but the characteristic Upper Pleistocene forms, as for example *Elephas primigenius* and *Bos primigenius*, have not appeared. It seems that the intensity of cold in the fourth glaciation and the aridity which preceded and succeeded it in the later parts of the Upper Pleistocene were the causes finally of the disappearance of the Pleistocene fauna.

The close relationship of human cultures to the geological sequence is described later.

CAUSE OF THE ICE AGE

The cyclical character of the glacial and sedimentary curves and their correspondence has been remarked upon. It seems, therefore, that all over the world there has been a coincident series of changes in precipitation. Moreover, the curves show a progressive decrease in 'swing'; that is, the cycle of change decreases in amplitude from the beginning of Middle Pleistocene times onwards. A glance at any set of terraces would be convincing enough on this point. This decrease in amplitude is essentially a curve of recovery, the first stages in the Lower Pleistocene being the shorter 'build-up' towards the maximum, and the later stages the longer recovery. Obviously the catastrophe from which recovery has taken place must have occurred in Tertiary times.

In the north, in Scotland, Scandinavia, Greenland and Arctic Canada, a consistent set of physiographical features can be seen. A high-level plateau surface of mature form is surmounted by monadnocks which have undergone the effects of extreme frost-shattering and are now sharply

'Alpine' in appearance. Cut out of this old land surface are deep steep-walled canyons and fjords, which follow lines of weakness determined by major joint planes, and often, therefore, show a cruciform appearance. In both Baffin Land and Norway the fjords obviously constitute entrenched drainage systems cutting through ranges of uplifted mountains, for example, the Sogne Fjord. The matured plateau form slopes away on either side of this backbone, hence the fjord system has cut back and captured on the inner side of the range. This is well shown by the run of obsequent forms near the head waters of some of the main fjords which have so cut back. Where the system is merely entrenched into the older plateau form, which is the most common type in Norway, the heads of the fjords are very steeply graded. Further signs of rapidity of entrenchment is the presence of dry valleys—steep-walled, fjord-like in character—which have been partly cut during first stages of erosion, and left dry when the eroding stream was diverted by capture into the deeper main fjords. This is a well-marked phenomenon in eastern Baffin Land and also occurs, though sparsely, all over western Norway and in Scotland too.

That these fjords were due to the action of fluviatile, sub-aerial, erosion is demonstrated not only by the above evidence but also by V-shaped forms of the wider valleys, truncated spurs and, quite often, the serial right-angled bends in the courses of the fjords due to the intersection of major joint structures. The erosive power of ice in such valleys must have been greatly reduced. The V-shaped forms nevertheless show oversteepening due to glacial action. The valley sides in the upper parts of the fjords have composite profiles, for erosion during interglacial periods was apparently as strenuous (measured in depth) as that during glacial, and the result is a succession of V- interrupted by U-forms.

Corresponding to these older glaciated profiles are a series of three cirque types—old, mature, and young—which seem to correspond to the first two, the third, and the fourth glacial stages respectively. The terraces within the fjords are associated with the third, fourth and fifth glacial advances (and their substages) and with post-Pleistocene oscillations. The old cirques in the main fjords come well down to present sea-level, and are occasionally even drowned. The skjaergard is cut out of it and itself glaciated, and is thus Middle Pleistocene in age. Finally, the fjords are cut out of Tertiary rocks in Greenland and Canada ; therefore the fjords must be, at the oldest, of late Tertiary age.

As a whole the evidence shows that during the latter period there was widespread uplift, in places over 4,000 feet, of a block comprising the Scandinavian Shield, Greenland and the northern part of the Canadian Shield, the result of the great Tertiary tectonic activity. Simultaneously, the poles shifted. The North Pole, in early Tertiary times situated in the north Pacific, moved towards its present position ; that is, the poles became coincident with the newly uplifted block in the north, and the antarctic continent in the south.

Furthermore, it seems that precipitation increased, for it is unlikely that the rivers which established the mature Tertiary landscape would have been able to erode the incised fjord system. To account for this increase of precipitation, it is suggested empirically that polar shift and crustal deformation led to such a variation in geography that the precipitational norm had to be adjusted. The matter still awaits mathematical treatment. Given these conditions, it will be seen that the explanation of glacial and interglacial periods can be achieved by application either of Simpson's theory or of Croll's radiation curve. On broad grounds it appears to me that Simpson's theory fits the facts on a wide basis, accounting for the precipitational changes in other parts as well as glaciated regions.

After uplift, recovery : the land subsided and the fjord systems were drowned. The deep valleys incised into the continental shelf during the period of exposure were drowned and became submarine canyons. Later, ice sheets filled these canyons near the ice peripheries with detritus. Decreasing compensatory oscillations proceeded well into the Pleistocene and were materially affected by secondary factors such as ice load. As glaciation lagged behind uplift, so the glacial and sedimentary curves of recovery lagged behind the curve of isostatic recovery. The coincidence of crustal deformations over wide areas is significant, and one suggestion may be hazarded here. The last expedition led by Col. Seymour Sewell to the Indian Ocean demonstrated the existence of a submerged rift feature the mirror image of the African Rift Valley. The major part of the rifting occurred in late Tertiary times, that is, when uplift occurred in the northern hemisphere. (Somewhat similar uplift occurred in the south, as witnessed by the physiography of New Zealand and South America.) Bullard has demonstrated that the rifting is due to pressure, not tension. The two regional adjustments may be intimately related, for crustal pull at the poles will produce longitudinal shrinking and therefore pressure at the equator. This same shrinking may take the form of crustal drift (and hence orogenic movement) in a direction at right angles to the shrinking. Thus would occur mountain-building movements in an east–west direction, the Himalaya, the Caucasus, the Alps.

(To be continued)

M. V. LOMONOSOV (1711-1765)*

By PROF. J. D. BERNAL, F.R.S.

THERE are few names in the history of science that have been more strangely passed over than that of Mikhail Vasilyevich Lomonosov. Because his life was spent for the most part beyond the confines of the scientific world of the eighteenth century, his ideas and his influence never made themselves felt outside Russia, but there he is revered as the real founder of Russian science with as just a title as Liebniz in Germany, or Franklin in the United States.

No one could have excelled him in his determination to pursue and develop science. He was born the son of a poor fisherman on a remote island on the fringe of the Arctic Circle. Although Russia was then, apart from the newly formed capital of Peter the Great, sunk in complete barbarism and ignorance, he forced his way to knowledge. At the age of nineteen he went to Moscow, where, passing as a priest's son, he managed to enter a monastery school which could teach him little but Latin and church Slavonic. Three years later he was called among the most gifted pupils to the newly formed Academy at St. Petersburg, at this time an entirely foreign creation. The Government wanted to train native Russians in prospecting the great mineral resources of the country and in setting up new industries. Lomonosov was one of three who were sent abroad for this purpose. He studied mining at Freiburg, and general science under the great Christian Wolff at Marburg. There at last he came into contact with the full stream of eighteenth century scientific enlightenment, and when he went back to Russia four years later he was able far more effectively than his foreign colleagues to introduce that spirit into his country.

It would have been remarkable enough if Lomonosov had acted as an apostle of scientific culture in Russia, but he was far more than that. Brought up out of contact with the whole tradition of the West, he was, after a few years' study, able to grasp it and in a large measure to transcend it. Possibly because of his very freedom from preconceived ideas, his work shows him to have possessed a clear comprehension of physical and chemical principles a century before they won general recognition. Lomonosov's writings are few, and mostly buried in the archives of the St. Petersburg Academy, but each one of them is an expression in the most orderly and clear way of some fundamental principle in physics or chemistry.

In a century when chemical theory was deeply buried in confused mysticism, Lomonosov introduced clear and precise terms. In his "Elements of Mathematical Chemistry" in 1741, he gives definitions of elements, compounds and molecules which would pass muster to-day. Even more surprising was his description of the structure of solids, liquids and gases, and his first statement of the mechanical theory of heat and the kinetic theory of gases, leading him, in particular, to postulate the existence of an absolute zero. His analytical mind refused to deal with such concepts as phlogiston or fiery principles; to him the increase in weight of metals on calcination was due to the combination of atoms from the air which could be expelled on further heating. But lacking the devices of pneumatic chemistry, he was unable to anticipate the discoveries of Priestley.

In physics, Lomonosov's chief contribution was to meteorology (where he devised an anemometer) and atmospheric electricity. His colleague Richter was the first victim to the study of lightning that Franklin had started. Lomonosov speculated acutely on the causes of the aurora and the importance of cold fronts in weather changes. Perhaps more remarkable than any individual achievement is the way in which Lomonosov understood the nature of systematic scientific inquiry. This is shown very clearly in his lectures on "Real Physical Chemistry" in 1752. He is particularly insistent on the need for quantitative methods in chemistry, and for the measurement of all physical properties connected with chemical reactions. Of the relations between physics and chemistry he wrote: "A physicist without mathematics is blind, without chemistry he is paralysed". His understanding is shown best by his research programmes, which he initiated and carried out in the new University of Moscow, of which he was the founder and first principal. Unfortunately the note-books containing his results have been lost, but the programme of the work shows its comprehensiveness. On the solution of salts, for example, he proposes to measure:

(1) The solubility of all principal salts at different temperatures.
(2) Density of different solutions.
(3) The change in volume on solution.

* Substance of a lecture delivered on June 28, under the auspices of the Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R.

(4) Change in temperature on solution.
(5) Variation of the density with temperature, to the freezing point.
(6) Effect of solution on the boiling point.
(7) Specific heat of the solution.
(8) Mutual effect of different salts on each other's solubility.
(9) Rate of freezing.
(10) Effect of dissolved air.
(11) Whether solutions self-cooled regain heat as rapidly as those cooled externally.
(12) Effect on cohesion.
(13) Refractive indexes of solutions.
(14) Capillary constants of solutions.
(15) Microscopic examination.
(16) Effects of pressure in a Papin's digestor.
(17) Effect of an electric field.
(18) The colour of electric sparks and arcs in solutions.
(19) Comparison of solutions in vacuum and in air.

We are still trying to complete the programme he here sets out, but its recitation is enough to show what an extremely modern view he held in physical chemistry.

The distinctive character of Lomonosov's work was that he combined the mathematical inheritance of the Newtonian era, which he no doubt derived in the first place from his master and friend Euler, with an extremely lively and detailed interest in the actual phenomena of Nature and in the practices of the arts. We can recognize now a general relative decadence of science in the middle of the eighteenth century, a turn to formal mathematics and experimental dilettantism. Lomonosov stands out against this background, and foreshadowed the great work of the period of the French Revolution. He resembled Lavoisier in his mental approach to the problems of chemistry. His curiosity, though insatiable, was ordered and practical, and he was an organizer of research as much as a thinker.

Here we have a scientist of the first rank, but Lomonosov was a great deal more than that. His most important immediate influence was in quite a different sphere, that of philology and poetry. He is still revered as the first native Russian poet, and Pushkin repeatedly acknowledged his debt to him. He wrote the first Russian grammar as well as the first modern Russian history. All through his life he struggled against the cramping influence of the traditional and clerical obscurantism of old Russia and the trivial and pedantic atmosphere of the Court and the Academy. Unlike many more famous men he was never deceived by the flattery of the great, but worked steadily for the education of the Russian people.

How was it that with all his ability and achievement his work seems to have had so little immediate consequence in the world of science? Partly no doubt because of the distance of Russia and the degree to which it was cut off from the active world of English, Dutch and French science; partly because of the jealousies and vested interests of the foreign academicians; but most of all it was due to the backwardness of life in Russia, of which Lomonosov himself was so well aware when he lamented that there was no one to understand him or to carry on his work. But Lomonosov's work did not go unrewarded, however little immediate influence it had in the West. It was to him that the great liberating influence of scientific thought in nineteenth century Russia was largely due. But it is only in the past twenty years that Lomonosov's aspirations have been realized. The Soviet Union is now celebrating his 175th anniversary; but it is the utilization of the resources of the country and the spreading of scientific education to all that marks the real culmination of his work.

OBITUARIES

Mr. O. Gatty and Mr. A. S. Chessum

OLIVER GATTY, who died on June 5 at the early age of thirty-two from an accident when engaged on research in the service of his country, was an investigator of exceptional calibre and promise and possessed a mind of unusual capability. From Winchester he went to Balliol College, Oxford, where he obtained a 'first' in chemistry in 1930. In 1931 he was elected to a tutorial fellowship at his College. His interests, however, were in research rather than in teaching, and two years later he resigned in order to visit Rothamsted, where he became interested in the mechanism of living processes. He left Rothamsted to work with Prof. J. Gray in the Department of Zoology at Cambridge, and later joined my Laboratory.

Gatty showed that all the phenomena such as passivity and corrosion attending the immersion of metals in solutions of electrolytes could be interpreted on the basis of local action currents involving the presence of anodic and cathodic areas. It was with this background that he approached the subject of biopotentials. He quickly realized that thin layers of insoluble substances could not affect the electric potential difference between two phases in equilibria, but that they might produce profound effects if there existed a diffusion potential between the two phases. These diffusion potentials are in all probability the

result of continuous enzymitic processes. The ionic permeability of the thin interphase membrane thus becomes one of the important factors in the magnitude and sign of the biopotential. Gatty carried out a series of interesting experiments on frog skin, and showed that all the bio-electric phenomena observed with this material could be accounted for if the frog skin were regarded as electrically equivalent to a resistance in series with areas permeable to anions and cations respectively. He made the further tentative suggestion that the cathodic areas might be the pores between the cells.

Gatty could dissect a complex problem into its simpler components and bring to bear on each a mind possessing the unusual faculty of not only visualizing the mechanical nature of the problem, but also of combining with this mathematical analysis.

He was a man with wide interests, attending the Ottawa Conference in 1932, and was a member of the Spitsbergen Expedition of 1933. He was likewise deeply interested in psychic phenomena. His personal charm, his humour, and his unvarying kindness and sympathy for the underdog won him many friends, both in and outside the Laboratory. Although I knew Oliver Gatty for all too short a period, he was rapidly becoming one of my closest friends.

ERIC K. RIDEAL.

ALFRED STANLEY CHESSUM was for thirteen years a member of the workshops staff of the Engineering Laboratory of the University of Cambridge. He was an exceptionally brilliant craftsman—a man endowed with ability to think round his work and capable of producing anything within the capacity of the plant entrusted to him.

These qualities singled him out, and consequently he was chosen to build the apparatus for Mr. Gatty's experiments. Chessum's enthusiasm for this work was possibly only excelled by that of Mr. Gatty himself, and many of Chessum's ideas were incorporated in the design. He understood the urgency of this problem and worked quickly to produce the apparatus in the shortest time. The tragic circumstances which ended this series of experiments have robbed this department of a pleasant and cheerful personality, and a man whose sound common sense and outstanding qualities must be considered irreplaceable.

C. E. INGLIS.

Prof. J. H. Muirhead, F.B.A.

PROF. JOHN HENRY MUIRHEAD, who died on May 24, carried his eighty-five years so lightly, his vigour of mind was until the last so abundant and his sympathy with young life and new ideas so unfailing, that it is hard to think of him as what he was, perhaps the last surviving representative of the Idealist philosophy that had its heyday in the eighteen-eighties and nineties. But as a pupil of Edward Caird in Glasgow and of T. H. Green at Balliol, he had been in the movement from its beginning and was to watch its extending influence far beyond the ranks of academic theory, then, in the last generation, its decline before the criticisms of younger movements. If not one of the leading thinkers of the school, Muirhead was certainly one of its most successful and indefatigable teachers, both directly for more than a generation in university posts and indirectly through his wide personal contacts, through his work for the British Institute of Philosophical Studies and in many other ways, while his writings cover a period of not far short of half a century. Finally, as a foreign critic has remarked (Dr. R. Metz, "A Hundred Years of British Philosophy"), Muirhead "made a distinguished contribution to the history of the idealistic movement. Placing it in a wider intellectual setting, he has sought to understand its origin and development as well as its total significance". The reference here is especially to his book on "The Platonic Tradition in Anglo-Saxon Philosophy" (1931).

Muirhead's own special interests were mainly in the bearing of philosophy upon human life and the social sciences. His first book, "The Elements of Ethics" (1892, fourth edition 1932), has for long been widely used as a text-book; he used to enjoy telling how some years ago it was banned in Japan because of a passage misinterpreted as putting forward a defence of tyrannicide. "Philosophy and Life and other Essays" (1902), "The Service of the State" (1908), "Social Purpose" (in collaboration with Sir H. J. W. Hetherington) (1918), "The Use of Philosophy" (1928), "Rule and End in Morals" (1932) are indicative of this primary interest, as is his last published work, the Herbert Spencer Lecture delivered at the University of Oxford less than two years ago on "The Man versus the State". His little book on "German Philosophy in Relation to the War", written in 1915, was a corrective to certain war-time prejudices for which there is again a use to-day.

As general editor of the series "Library of Philosophy" over a long period of years, Muirhead not only displayed his own catholicity of sympathy and interest in thought of widely different tendencies but was also instrumental in introducing to the English reader the works of eminent foreign and American thinkers such as Bergson, Croce, Varisco, Radhakrishnan. He was also general editor of a valuable collection of personal and autobiographical statements "Contemporary British Philosophy" (1924-25). Up to the end of his life he always delighted in opportunities to hear from practising men of science in chemistry or physics or biology to what tentative general conclusions, if any, their researches were leading them. He was a great appreciator and conciliator, and many workers in more specialized fields must feel grateful to him for his breadth of outlook and his unshaken faith in "Man's Unconquerable Mind".

JOHN W. HARVEY.

WE regret to announce the following deaths:

Major P. H. G. Powell-Cotton, founder of the Powell-Cotton Museum of big game at Birchington, on June 26, aged seventy-three.

Sir Raymond Unwin, an authority on town planning, aged seventy-six.

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NEWS AND VIEWS

Wildlife in the Channel Islands

THE German occupation of the Channel Islands interrupts a good number of years of continuous, sound biological field work conducted by the Jersey Branch of the British Empire Naturalists' Association amongst a fauna and flora unique in the British Isles for representing the northern limits of many Mediterranean species. Its air fauna has been shown to be rich in nesting species like peregrine, puffin, raven, guillemot, razorbill, oyster-catcher and various gulls, while the flora includes the first European station for the American club-rush (*Scirpus americanus*), which was probably introduced to St. Ouen's pond by wild-fowl, the only British station for the Jersey bugloss, and also the yellow broomrape. There are also such interesting plants as sea-scabious, spotted rock rose, the beautiful hyssop-leaved loosestrife, clustered trefoil, four-leaved alseed, evergreen alkanet, spreading star-thistle, five-spotted catchfly, French pink and proliferous pink growing about the quarries, the cliffs, or the shore.

The Rev. P. Burdos and Mr. H. J. Baal have for some years made a study of the bird life of the islands, and Mr. E. R. Casimir has recorded much of the flora. In winter the islands are so mild that at Christmas it is the normal thing to find some forty species of plants in flower. A great deal of low-tide research has been carried out at L'Etacq under the supervision of Mr. Baal and others, and the marine specimens exhibited at the States of Jersey Library; butterflies on the Queenevais were also watched and recorded, especially in relation to the migrations from France to Britain. Special efforts were made to conserve the wild life in the pretty Belle Hougue valley. Recorders have long debated whether records from the Channel Islands (and from the Scilly Isles) should not be credited to the British list, but to the French lists. The geology is mostly French, although where the granite predominates the scenery resembles Devon and Cornwall.

Purchase Tax on Books

MR. KENNETH LINDSAY asked the Chancellor of the Exchequer in the House of Commons on July 2 whether he would exclude the book trade from the Purchase Tax, in view of the dependence of book exports on the volume of home trade and the vital importance of the book industry to the moral of English-speaking peoples, but Sir Kingsley Wood said that he had given careful and sympathetic consideration of the matter, and regretted that he could not exempt the publishing trade from making this contribution to the revenue needed for the prosecution of the war. It is legitimate comment on this reply to point out that while the tax is collected from the publishing trade, the cost of the tax must fall on the public. As we have already pointed out (NATURE, May 11, p. 719), it is against the public interest both from the financial and the intellectual point of view to place a check on the sale of literature, a substantial proportion of which represents export business. The position is totally different from that in many other industries, where export trade does not depend on sales in Great Britain, and where it is desired for various reasons to reduce consumption at home. It is to be hoped that the Government may yet find a way of relieving the industry of the proposed burden.

Shortage of Ergot

AN open request has been made to medical practitioners by the War-time Requirements Committee appointed by the Medical Research Council to observe strict economy in prescribing ergot. This is one of a remarkably small number of important drugs which have become scarce since the War began. The primary reason for the scarcity is not the present War so much as the Spanish Civil War, for Spain has not recovered her trade in this valuable item of *materia medica*, which was neglected during the period of domestic strife. Other countries which supplied substantial quantities of ergot were the U.S.S.R., Poland and particularly Portugal. Supplies of Russian material available to other countries have been steadily diminishing for the past two years, because the bulk of the output is reserved for use in Russia itself. The cessation of Polish supplies was, of course, a direct consequence of the War. In the last two years, the crops of Portuguese ergot have been below normal; indeed it is said that the last crop was a failure. Thus the world outside Germany and certain mid-European countries where sufficient quantities of the drug are produced for domestic requirements has had to depend mainly upon the diminished output of Portugal. Very large quantities of ergot, which is a fungus parasitic on the rye plant, are prescribed in general midwifery practice and in maternity hospitals, but it appears to be the view of the Medical Research Council that the prescription of ergot could be greatly reduced without prejudice to patients.

Royal Aeronautical Society: New President

MR. GRIFFITH BREWER, who is an honorary fellow of the Royal Aeronautical Society, has been elected president of the Society for the year 1940–41. Mr. Griffith Brewer was born in London in 1867 and commenced ballooning so long ago as 1891. When Wilbur Wright went to France in 1908, Mr. Brewer was his first English passenger. From then on he devoted his attention to aeroplanes and in 1914 learnt to fly at the Wright Field at Dayton, Ohio. During the War of 1914–18 he was honorary adviser to the Airship and Kite Balloon Services at Roehampton from 1915 onwards, and made experiments with ripping kite balloons in the air after breaking of the cable for the R.N.A.S. during 1917–18. In 1912 he founded the Wilbur Wright Memorial Lecture. More recently he has delivered addresses at Dearborn (1938) and at Massachusetts Institute of Technology (1938)

on the Wright Brothers' scientific research. It was largely due to Mr. Brewer's efforts that Mr. Orville Wright has lent his original aeroplane, on which the first power flights were made at Kitty Hawk, North Carolina, to the Science Museum, South Kensington, where it has been for the past twelve years.

Philip Syng Physick (1768-1837)

IN an address recently delivered before the Royal Society of Medicine (*Proc. Roy. Soc. Med.*, **33**, 145; 1940) Dr. George Edwards gives an interesting account of Philip Syng Physick, "the father of American surgery". He was born on July 7, 1768, at Philadelphia, where he graduated in the Faculty of Arts at the age of seventeen. In 1788 his father, who was receiver-general of the Colony of Philadelphia, took him to London, where he became a student at St. George's Hospital and served first as a dresser and then as house surgeon to John Hunter. In 1790 he received the diploma of the Royal College of Surgeons. In the following year he went to Edinburgh, where he obtained his doctorate with a thesis on apoplexy, which he dedicated to John Hunter. In 1792 he returned to Philadelphia, and two years later was appointed to the staff of the Pennsylvania Hospital and that of the Philadelphia Dispensary. He rapidly gained an extensive practice owing to his surgical skill, particularly in two operations, namely, enucleation of the lens, and removal of stones from the bladder. He devised several new operative methods and surgical instruments, including improved treatment of chronic ulcers, fractures and dislocations, the invention of a tonsillotome and of a forceps for controlling hæmorrhage, and various modifications of catheters.

In 1800 Physick was appointed professor of surgery at Philadelphia, and held this post until 1819, when he succeeded his nephew, John Syng Dorsey, in the chair of anatomy. He retired in 1831 at the age of sixty-three, and was unanimously elected emeritus professor of surgery and anatomy "as a tribute to his merit in elevating the character of the school and in promoting the advance of medical science". He received many honours at home and abroad. From 1824 until his death thirteen years later he was president of the Philadelphia Medical Society; in 1825 he was the first American to be elected a member of the French Royal Academy of Medicine, and in 1836 he became an honorary fellow of the Royal Medical and Chirurgical Society of London, the predecessor of the Royal Society of Medicine. He left no writings of importance, but his methods and teaching are embodied in Dorsey's "Elements of Surgery" (1813), which went through three editions, and Gibson's "Institutes of Surgery" (1824). He died on December 15, 1837.

Hagiological Healing

THE April issue of the *Bulletin of the History of Medicine* contains a richly documented article by C. Grant Loomis of Harvard University summarizing some of the aspects of miraculous healing which will be of interest to the anthropologist and folklorist as well as to the medical historian. While most of the miracles on record appear to have been accomplished solely by prayer and sincere belief in the efficacy and intercession of holy men, additional factors in a number of cases have been superadded to the simple act of faith. In some conditions, for example, such as deafness, paralysis, headache, poisoning, blindness and severed members, the efficacy of saliva has been reported (see NATURE, April 13, 1940, p. 585). The external or internal use of water in which the saint has washed himself has been employed for numerous complaints, especially blindness, fever and insanity. Other fluids such as blood from a holy corpse, sacred oil from various sources, milk from the mothers of saints and wine from the chalice or hand of a saint have also been credited with curative properties. In many instances, sacred dust, earth or mud from the houses or burial places of saints have served as the chief element in cures, while grass and flowers from their tombs have sometimes proved beneficial. Relics of all kinds have been used for various ills not only in individuals but also in the control of epidemics. All the major saints and some of the minor ones have been credited with miraculous healing power, but it was exceptional for them to have employed popular remedies.

Jewish-Christian Intermarriages in Budapest

IT has become a commonplace of sociological and economic argument that the rapid increase in facilities of transport and inter-communication between peoples geographically remote from one another has made the world 'a small place'. Evidently it has a profound biological effect upon humankind in the aggregate, diminishing steadily by interbreeding the innate biological differences that formerly existed between races and other differentiated groups of human beings. Prof. Raymond Pearl, when discussing a few years ago the future of war as a phenomenon and a social agent, stressed this tendency to uniformity in human beings as well as its effect in the slow and steady weakening of the religious and social taboos which inhibit mixed marriages. While there is general agreement that interbreeding is taking place at an accelerated pace at the present time, there is very little in the way of precise statistical observation by which this conclusion can be proved and quantified.

Valuable material pertinent to the issue has been drawn by Prof. Pearl from successive volumes of the municipal archives of Budapest, covering the period 1897–1935. From the marriages recorded in this period, of which Prof. Pearl has plotted the figures to show the trend of Christian, Jewish, and mixed marriages (*Bull. Hist. Med.*, **8**, 3; 1940), it would appear that the proportion of Jewish and Christian marriages to all marriages of either Christian or Jews increased generally throughout the period and to a marked degree, being 2·6 per cent greater to all Christian marriages in 1935 than in 1897, while it was 3·05 per cent greater to all Jewish marriages in the same year. Since 1925, however, the proportion of mixed Jewish and Christian mar-

riages to all Jewish marriages has slightly increased, whereas the proportion to all Christian marriages has declined slightly. This is attributable to a decline in the Jewish population and an increase in the Christian after 1919. There is a further tendency to be noted in the fact that a greater number of Christian brides marry Jewish men than of Jewish brides who marry Christian men. Here again there is a marked increase in the differential between the two types in the post-War years.

New World Origins

FOR long the amazing efflorescence of indigenous culture among the Mayas and Aztec of Central America was the only aspect of American archæology to attract the serious interests of European students. Even the intensely absorbing question of the origin, character and chronology of such alleged early skeletal remains, germane as it was to the inquiries of human palæontology and ethnic origins in the Old World, received less attention than it deserved. Extravagant claims for the antiquity of man on the American continent, readily demolished in most instances, were no doubt responsible for something more than a certain reserve in the approach to the general question. All this has to a great degree been changed, and the discovery of the Folsom point in New Mexico and other regions of the south-western United States in clear association with an extinct fauna has now placed the discussion of the antiquity of man in America and the early cultural history of the continent on a basis which enables British archæologists to enter upon the discussion of a problem conditioned by data of which they have a ready understanding and with which it may be said they have at present a closer acquaintance than their American colleagues. This is implicitly admitted by Prof. E. B. Renaud, one of the pioneers in the study of Folsom man, in his most recent published work.

The literature of Folsom man is already large ; but to those who have not been able to follow it closely, we may commend an excellent critical analysis which is part of a discussion of the whole question of New World origins appearing in *Antiquity* of June, by Dr. J. Grahame D. Clark, whose experience of analogous European stone age cultures carries great weight. His typological argument on the much debated question of the relation of the Folsom point and the more generalized Yuma point therefore deserve careful attention, although the recently discovered northward extension of the Folsom point so far as Canada may be found to have greater significance than as yet has been attached to it.

"Elephants and Ethnologists"

AN echo of the famous "Elephants and Ethnologists" controversy appears in a contribution by Mr. W. Balfour Gourlay in *Man* of June 1940. This controversy, it will be remembered, turned on the alleged occurrence of representations of the elephant in the Mayan sculptures of Central America, which were held to demonstrate the Asiatic derivation of Central American culture, while others held, as it has been put, that the elephants had trampled finally on the theories of the Diffusionist School of Elliot Smith, Perry and their followers. Mr. Gourlay refers in the first place to a discovery brought to his notice at Guadalajara, Jalisco, in Mexico. Here it was stated human and elephant bones had been found in association. He did not see the find *in situ*, but his subsequent inquiries leave no doubt that the position of the human bones was due to burial.

A more intriguing evidence was observed by Mr. Gourlay in 1921. It left him in little doubt that man had lived in Central America in contemporary association with some elephant-like creature. This was a primitive and almost life-sized representation of the head of a strange animal carved from a block of black lava which then stood on a pedestal outside the museum at San Salvador. The statue, of which two photographs are shown, was about two feet high. The animal bore a trunk, too long for that of a tapir, too short for an elephant. If it was intended to represent an elephant, the artist evidently had never seen one, and did not understand its anatomy, as the eyes were placed in the middle of the ear-lobes. Sir Grafton Elliot Smith, to whom the photographs were shown, was convinced that an elephant was intended, much copying being responsible for the departure from realism ; but the author is not convinced and regards it as a problem demanding solution.

Attracting Birds

IN earlier less sophisticated days the desirability of attracting birds was accepted without question. Now doubts have arisen, partly because it is recognized that some birds may do some harm to man's possessions, and partly because the congregating of birds at a common feeding ground may lead to the spread of diseases among the birds themselves. These dangers are recognized and provided for in a new pamphlet, the first of a series of Conservation Bulletins, issued by the Bureau of Biological Survey of the U.S. Department of the Interior. In it W. L. McAtee summarizes clearly and with line illustrations suitable methods of encouraging nesting, and discusses the proper foods to be supplied to a number of the commoner birds of the States. His hints apply equally well to many British birds, and particularly useful will be found a short section dealing with common cultivated annual plants which may be sown for the encouragement of seed-eaters such as siskins, gold-finches and other finches. For fruit-eating birds there is a short list of shrubs and trees the fruits of which persist into the winter, when the birds have most need of them. It is a useful list for anyone wishing to create a shrubbery likely to be appreciated by winter bird visitors.

Significance of Television

AN instructive address on television given at Buenos Aires last year by Mr. W. E. Tremain, chairman of the Argentine Centre of the Institution of Electrical Engineers, is published in the May issue of the *Journal of the Institution of Electrical Engineers*.

Mr. Tremain begins by saying that the more we study recent developments in television, the more we are forced to realize that high-definition television is one of the outstanding scientific and engineering achievements of our time. In August 1936, the Alexandra Palace transmitter in north London was in full operation, giving the first public television service in the world. On May 12, 1937, the Coronation procession was televized with much success. It was the first outside television exhibition of importance. In conclusion, Mr. Tremain points out that television is destined to play in the future a leading part both as a means of communication and as a means of instruction. When planning for the future, it is important to bear this in mind. In England, as a result of pressure both from the cinema and radio industries, the experimental work being conducted for the purpose of extending the television service in the provinces was expedited. If a definite decision be taken with this end in view, we can look forward hopefully to it giving much direct employment in happier times.

Standardizing Electric Distribution Cables

MR. S. W. MELSOM, of the staff of the Cable Makers' Association, has contributed a paper on the standardization of cables and equipment, with the object of reducing distribution costs, to the *Electrical Review* of June 7. Discussions have been going on for several years in order to frame an acceptable set of rules. The outbreak of war prevented the embodiment in the revised British Standard Specification for mains cables of the discussions during the last two or three years. The selection of standard sizes for cables to be used in a low-voltage network is a matter almost entirely for the supply engineers. It is difficult to forecast accurately the load which a distributor will have to carry, and since the data on which estimation has to be based are somewhat nebulous, there are strong reasons for the adoption of a few—possibly not more than two—standard sizes for a given system of low-voltage four-core cables.

Since the size of the undertaking and the load-density in the cable must vary between districts, it has been suggested that three sizes of four-core cable are required, namely, 0·1, 0·2 and 0·3 sq. in., the smaller sizes being sufficient for the smaller systems and the larger for larger systems. Some suggest also that it would be more economical to use shaped and not circular conductors. The initial difficulties experienced in the construction of this type of cable have been overcome by the use of special apparatus. It is believed that the shaped conductor is quite as satisfactory as a circular conductor and is better technically. Difficulties have been experienced as to the best colours to use to identify the cores. The proposals that have been put forward envisage leaving the colours to the switchboard manufacturers and using numbers for the identification of cable cores. The questions of factor of safety and cost, now nearing solution, have involved a very large amount of work on the part of designers, research laboratories and testing authorities and great improvements are in immediate prospect.

An Automatic Distress Signal

THE Ministry of Shipping has given its approval to the 'Raft-o-Lite' safety flashing light of the International Marine Radio Co., Ltd., 63 Aldwych, W.C.2. It comprises a battery and light in a water-tight case, provided with a float so that it will assume a vertical position when floating in the sea. A flasher is incorporated with it and this is designed to emit automatically the international distress signal 'S.O.S.'. When stored in an inverted or horizontal position the light is not in use, but when thrown into the water it assumes a vertical position and the flashing light is automatically switched on, continuing for forty-eight hours at least. The manufacturers point out that these lights are particularly suitable for oil-burning ships and tankers, where oil on the water may render dangerous the use of open flares.

Breeding of Herbage Plants in Scandinavia and Finland

JOINT PUBLICATION No. 3, "The Breeding of Herbage Plants in Scandinavia and Finland" of the Imperial Agricultural Bureaux of Aberystwyth and Cambridge contains considerable information on the breeding of clovers and pasture grasses in Norway, Sweden, Denmark and Finland. The contributors are S. Nilsson-Leissner, F. Nilsson, E. Åkerberg, R. Torssell, H. N. Frandsen, H. Wexelsen, and O. Pokjakalliv. A significant feature of the work in these countries is that the breeding work on a given crop has led to the country becoming independent of foreign seed for that crop. It was found, for example, that selection of late strains of red clover from local strains improved the yield by 10 per cent, and such selections are now so popular in Denmark that it is unnecessary to import seed. Similar results are reported from Norway and Sweden, where resistance to *Sclerotinia trifoliorum* and Tylenchus, 'persistance' and winter hardiness are of particular importance.

Both in red clover and timothy grass, inbreeding has been found to lead to drop in yield, vigour and fertility, while the 'hybrid corn method' of crossing inbred lines to produce heterosis is scarcely practicable. It is found preferable to adopt plant selection and cross breeding to give natural selection full scope. Frost hardiness is selected for by removing the snow from timothy plants. Alsike and white clover together with various species of Lolium, Festuca, Poa, Agrostis, Dactylis, Bromus and other genera are being bred for commercial work. The more important varieties which have been raised and a list of the many plant-breeding stations in Scandinavia which are given in this useful publication indicate the extent of the work in progress.

Map of Antarctica

THE Antarctic regions have been of official interest to Australia since 1933, when the Commonwealth Government announced its claim to a large sector of the continent south of the Indian Ocean between the Ross Dependency of New Zealand and Enderby Land. The Australian Antarctic Territory embraces about one quarter of the Antarctic regions. The

Commonwealth Government has now published a two-sheet map of Antarctica by Mr. E. P. Bayliss (Department of External Affairs, Canberra. With handbook. 7*s*. 6*d*.). The map is on an azimuthal equidistant projection and has a latitudinal scale of 1 : 7,500,000. Known land, revised to the most recent discoveries, is shown in brown with valley glaciers in blue. Prominent peaks and heights in metres are shown. The ocean is blue, with soundings and bathymetrical contours. The names of the chief discoverers of lands are shown, and the territorial claims are indicated on the main map and on a smaller scale inset which shows relation with the southern continents. The recently claimed Norwegian sector is not marked as such. The coastal areas of the Australian Antarctic Territory are shown on another inset on a scale of 1 : 5,250,000. On many coasts the tendency to replace the term 'land' by 'coast' has been followed, but where no general name exists the multiplicity of 'lands' remains. The map is an excellent piece of work, with much detail, and is clearly printed. It should prove a standard map for some time. The accompanying handbook gives an account by Mr. J. S. Cumpston of recent exploratory works and cites most, but not all, of the authorities and explorers' records. It contains also an index to the map.

Pasteur Institute of India, Kasauli

IT is announced in the thirty-eighth annual report of this Institute, recently issued, that the anti-rabic treatment which has been carried on here for forty years has been transferred to the Central Research Institute, Kasauli. The Kasauli Pasteur Institute was formally opened for the treatment of dog-bite and similar cases in August 1900 under Major David Semple, R.A.M.C. It was the first Pasteur Institute to be established in the British Empire; in the first year 321 persons were treated, and the numbers increased year by year until in 1938 more than 22,000 persons received treatment. During its last year, 1938, 20,377 Asiatics and 1,817 Europeans received anti-rabic treatment at Kasauli and its associated centres, with 73 deaths, a mortality of 0·33 per cent, the lowest figure during its long history.

Demography of Eire

ACCORDING to the recently published returns of the March quarter, the marriages registered in Eire during this period numbered 3,509, which was equivalent to an annual rate of 4·7 per thousand of the estimated population, this rate being equal to that for the corresponding quarter of 1939. The number of births amounted to 14,110, of which 7,228 were of males and 6,882 of females. This represents a rate of 19·1 per thousand of the population, being 0·3 below the rate for the first quarter of 1939. The total included 460 illegitimate births, equivalent to 3·3 per cent of the total births recorded. The number of deaths registered during the quarter was 13,376, of which 6,887 were of males and 6,489 of females. The equivalent annual rate was 18·1 per thousand of the estimated population, being 0·1 below the rate for the first quarter of the preceding year.

Juvenile Literature

"500 Books for Children", by Nora E. Beust (Washington, D.C., 15 cents), is a pamphlet with a sound idea behind it. Capable selections from the present overgrown jungle of books are a great help, if not a necessity. The list is well arranged in three sections of advancing age and indexed with cross-references. With a host of new books, old favourites still keep their places, such as Kingsley's "Heroes", "Treasure Island", and Kipling's "Mowgli" and "Just So" stories. We looked for some time for the two immortal "Alices" and at last found them under C. L. Dodgson, who never would admit that he wrote them. Animals, flowers and Nature in general are well represented. Children can even get an idea of what happens inside the atom. The illustrations show two designs which have won special medals.

Announcements

GENERAL DE GAULLE, leader of the French Volunteer Legion, has appointed M. André Labarthe director-general of all French services connected with armaments and scientific research in Great Britain. M. Labarthe, who is thirty-eight years of age, has appealed to French engineers, men of science, and industrial workers to join the already large number of their colleagues who have enlisted as civilian workers in the Legion.

THE Minister of Labour and National Service has appointed Sir William Beveridge, master of University College, Oxford, and formerly director of the London School of Economics and Political Science, as commissioner to survey the available resources of man-power of all kinds and to report thereon with suggestions on the means by which these resources can be utilized fully for national purposes. The office of the survey will be at the Ministry of Labour and National Service, Montagu House, S.W.1, and Mr. A. Reeder, deputy director of statistics in the Ministry, will act as secretary to the survey.

THE Summer School in Social Biology arranged by the Educational Advisory Board of the British Social Hygiene Council, which was to have taken place at Westminster College, Cambridge, during August 1–8, has been postponed until the advent of more favourable circumstances.

DR. CHARLES SLATER, consulting bacteriologist to St. George's Hospital, London, who died on March 15, bequeathed £10,000 to St. George's Hospital for teaching bacteriology or research work in that science, £5,000 to the University of Manchester for the equipment and maintenance of the laboratories, and £4,000 to the University of Cambridge for teaching or research work in medical science.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Fission Products of Uranium produced by Fast Neutrons

IN continuation of our experiments on the fission of uranium by fast neutrons, we have been studying decay periods of various isotopes. In this communication we give the results on silver and cadmium isotopes.

The uranium oxide, U_3O_8, carefully purified and freed from its disintegration products just before the experiments, was exposed to fast neutrons produced by bombarding lithium with 3 Mev. deuterons of several microamperes from our cyclotron, as described in our earlier note[1]. The exposure ranged from a few hours to some fifty hours, according to the object of the experiments. From the irradiated sample, silver was separated as iodide or chloride, cadmium as sulphide. Each fraction, carefully freed from the known fission products of uranium such as barium, lanthanum, antimony, tellurium, iodine, molybdenum, etc., was examined for its activity.

The decay curves of the silver fraction, which were obtained from samples exposed for some fifty hours, showed two periods, 7·5 days and 3 hours. The former activity is probably identified with ^{111}Ag [2,3] and the latter with ^{112}Ag [3].

The decay curves of the cadmium fraction, which was obtained from long exposures, showed apparently three periods, fifty minutes, several hours and 2·5 days. The first activity is possibly an isotope reported by Dodé and Pontecorvo[4]. The second one was proved to be ^{117}Cd by the identification of indium activity produced through its series transformation in the following way. Cadmium sulphide from a sample irradiated for 3 hours was dissolved in hydrochloric acid three hours after the initial separation of cadmium. The solution, after an addition of indium nitrate, was treated with an excess of ammonia. The precipitated indium hydroxide was filtered off and examined for the activity. Its half-period was found to be 2·1 hours, which is due to the known isotope of indium ^{117}In [5]. We thus conclude that the activity of the cadmium fraction is due to ^{117}Cd, the half-life of which turns out according to our measurements to be about 5·5 hours.

Similar procedure was taken with the 2·5-day activity. The cadmium sulphide from an irradiated sample of long exposure was left for about twenty hours before dissolution in hydrochloric acid, until the cadmium isotope ^{117}Cd and its daughter product died away. The indium fraction obtained in the same way as above was examined for activity, and a half-life of 4·5 hours was obtained, which we identify with the known radioactive isomer of the stable indium isotope $^{115}In^*$ [5]. As a consequence, we conclude the 2·5-day activity to be due to a cadmium isotope ^{115}Cd.

It should be mentioned that Be + D neutrons from our cyclotron, and also neutrons slowed down by paraffin, do not appreciably produce silver and cadmium activities as above mentioned. The details of the experiments will shortly be given elsewhere.

The above investigations were carried out as a part of the programme of the Atomic Nucleus Sub-Committee of the Japan Society for the Promotion of Scientific Research. We acknowledge the assistance given by our laboratory colleagues in connexion with the irradiation of samples and by Messrs. N. Saito and N. Matuura regarding the chemical separations.

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May 3.

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Mass-Radius Relation for a White Dwarf Star

THE peculiar difficulty pointed out by Eddington regarding the ultimate fate of a white dwarf star led Fowler[1] to make the first application of Fermi-Dirac statistics to astrophysics in a fundamental paper which initiated a long series of investigations, particularly by Milne[2], in recent years. The starting point is the expression

$$a(\varepsilon)dt = \frac{gV(2m)^{3/2}}{4\pi^2\hbar^2}\,\varepsilon^{1/2}\,dt, \qquad (1)$$

which represents (neglecting the effect of relativistic mechanics) the number of wave functions corresponding to eigen-values lying in the energy-range ε to $\varepsilon + dt$ for a *free* electron confined in a field-free region of volume V; this is assumed to hold for the stellar interiors though gravitational and electrical fields are present. For degenerate matter equation (1) leads to the well-known expression for the pressure

$$p = \frac{32\pi^3}{15}\,\frac{\hbar^2}{m}\left(\frac{3\rho}{4\pi g\mu m_H}\right)^{5/3}; \qquad (2)$$

which reduces the equation for mechanical equilibrium for a star to Emden's equation of index 3/2 giving the relation ("Emden-solution")

$$R = \frac{\alpha_0 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3} \qquad (3)$$

between the radius R and the mass M of a white

dwarf. L_0 is a length characteristic of the white dwarf theory

$$L_0 = \frac{\hbar^2}{m\, m_H^{5/3}\, G\, \odot^{1/3}} \doteqdot 6{\cdot}18 \times 10^8 \text{ cm.}, \quad (4)$$

and

$$\alpha_0 = \left(\frac{9\pi^2\, \omega^{\circ}_{3/2}}{128}\right)^{1/3} \doteqdot 4{\cdot}51, \quad (5)$$

where $\odot$ is the solar mass, m the mass of the electron, m_H the mass of the proton, G the gravitational constant, and $\omega^{\circ}_{3/2} = 132{\cdot}4$ is a number defining the Emden-solution of index 3/2. μ is the mean molecular weight per free electron, $\mu = 1$ for ionized hydrogen and $\mu = A/Z \doteqdot 2$ for any other completely ionized element of atomic weight A and atomic number Z. (The material in the interior of a white dwarf star is completely ionized due to pressure ionization.)

In the case of Sirius B—the most accurately known amongst the white dwarfs—the calculated radius for $\mu = 2$ (hypothesis of hydrogen scarcity) is smaller than the observed value by a factor somewhat larger than 2, but is in accord with observation if the stellar material is assumed to contain about 70 per cent of hydrogen by weight (hypothesis of hydrogen abundance).

However, the hypothesis of hydrogen abundance, as recently emphasized by Eddington[3], Wildhack[4], and Marshak and Bethe[5], is in violent disagreement with the theory of stellar energy generation. It predicts for the white dwarf a luminosity of an order far higher than the observed value, and so it must be discarded. With the elimination of the hypothesis of hydrogen abundance, relation (3) no longer remains in accord with observation.

The present note is concerned, *first* to direct explicit attention to the importance of the electric field in the theory of a white dwarf star, and *secondly* to give a derivation of the mass-radius relation (without recourse to equation (1)) which indicates a possibility of removing the discrepancy noted above between the observed and the calculated radii. We shall for simplicity consider a uniform-density model. As Rosseland[6] showed long ago, an electrical field is set up in a star which prevents any appreciable separation between the free electrons and the atomic nuclei, and for a model of uniform density we must have

$$Am_H u + ZeV = 0, \text{ or } ev = -\mu m_H u, \quad (6)$$

where u is the gravitational and v the electrostatic potential (both measured from the centre : $u = v = 0$ at $r = 0$). If ξ denotes the Gibbs' free energy per electron, then, from a well-known theorem in thermodynamics, we have

$$\xi_0 - \xi_1 = mu_1 - ev_1 = \mu m_H u_1, \quad (7)$$

where the suffixes zero and one represent the values at the centre ($r = 0$) and the surface ($r = R$) respectively. ($mu_1 - ev_1$) is the work done in carrying an electron from the centre to the boundary. For degenerate electron gas, if n represents the free electron concentration,

$$\xi = \frac{h^2}{2m}\left(\frac{3n}{4\pi g}\right)^{2/3}, \quad (8)$$

a result which is ultimately based on (1). Substituting $\xi_1 = 0$ and $u_1 = GM/2R$, we have from (7) and (8)

$$R = \frac{\alpha_1 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}, \quad (9)$$

$$\alpha_1 = \left(\frac{9\pi}{4}\right)^{2/3} \doteqdot 3{\cdot}68\,; \quad (10)$$

which is practically identical with (3), and is exactly the expression that is obtained by an application of the *virial* theorem[7]. If the electrostatic field be ignored, we obtain instead of (9) a relation of entirely different order of magnitude, namely,

$$R = \frac{m_H}{m}\frac{\alpha_1 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}. \quad (11)$$

The above discussion brings out explicitly the importance of the electric field in white dwarf theory. We shall now consider the derivation of the mass-radius relation from a different point of view, which appears to be more fundamental.

The Schrödinger equation for an electron inside a white dwarf is

$$\nabla^2\Psi + \frac{2m}{\hbar^2}(E - mu + ev)\,\Psi = 0, \quad (12)$$

which on using (6), and substituting for a sphere of uniform density

$$u = \frac{GM}{2R^3}\, r^2, \quad (13)$$

reduces to

$$\nabla^2\Psi + \frac{2m}{\hbar^2}(E - \tfrac{1}{2}\alpha r^2)\,\Psi = 0, \quad (14)$$

where

$$\alpha = \mu m_H \frac{GM}{R^3}, \quad (15)$$

This is the wave equation for a harmonic oscillator and gives for E the eigen-values

$$E_l = \hbar\left(\frac{\alpha}{m}\right)^{1/2}(l + \tfrac{1}{2}), \quad (16)$$

where l is any positive integer. The number of independent wave functions associated with the eigenvalue E_l is $gl(l + 1)/2$, where g is the weight factor ($g = 2$). In the *degenerate* case the levels from $l = 0$ to $l = l_0$ will be completely filled up, that is, $\sum_0^{l_0} l\,(l + 1)$ would be equal to the total number of electrons ; hence

$$l_0 = \left(\frac{3M}{\mu m_H}\right)^{1/3}. \quad (17)$$

The amplitude of the oscillator corresponding to the maximum energy E_{l_0} is to be identified with the radius R, and thus we have $E_{l_0} = \frac{1}{2}\alpha R^2$, which gives

$$R = \frac{\alpha_2 L_0}{\mu^{5/3}}\left(\frac{\odot}{M}\right)^{1/3}, \quad (18)$$

$$\alpha_2 = (24)^{2/3} \doteqdot 8{\cdot}32. \quad (19)$$

This is the same relation as (3), but the numerical factor is 1·84 times larger. For Sirius B, (18) gives $R = 1{\cdot}6 \times 10^9$ cm., whereas the observed value is 2×10^9 cm.

The theory here given needs to be refined in many ways ; thus the effect of electron collisions will be to broaden the energy levels, and it might be taken account of in the same way as in the theory of diamagnetism, but nevertheless it is interesting that the mass-radius relation has been obtained in this way.

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May 11.

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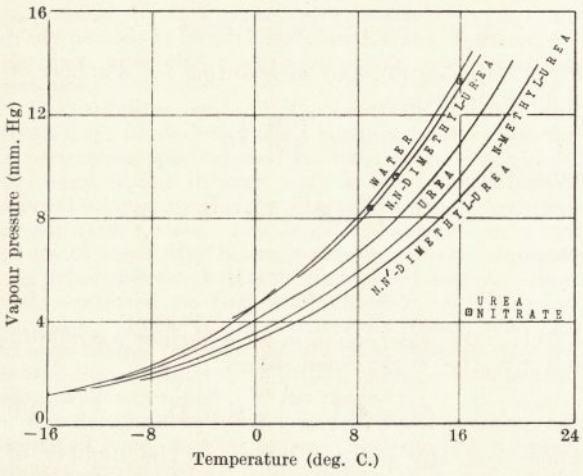
Deliquescence in Urea and Methyl-ureas

A COMMUNICATION in NATURE from E. A. Werner[1] directed attention to the deliquescence of urea and to the paucity of data concerning the vapour pressures of saturated solutions of urea and its derivatives, apart from the few observations of Adam and Metz[2], and Edgar and Swan[3]. The accompanying figure gives vapour pressure curves for saturated solutions of urea, urea nitrate, N-methyl-urea, N.N- and N.N′-dimethyl-urea determined by the method described by Rowley[4], and records the quaternary point for the system, urea, ice, saturated solution, vapour (−11·3° C.) for the first time.



The vapour pressure curves confirm the observations of Werner upon the absorption of water by urea, etc., the vapour pressure of a saturated solution of urea being at all temperatures below 20° C. less than 14 mm. of mercury; consequently urea will show deliquescence except under conditions of unusually low humidity. The actual humidity required to cause deliquescence in these compounds, expressed as a percentage of the maximum vapour pressure of water at 18° C., is:

Urea nitrate	> 95
N.N-Dimethyl-urea	94·3
Urea	80·1
N-Methyl-urea	70·0
N.N′-Dimethyl-urea	63·5

This shows N.N′-dimethyl-urea to be of the order of deliquescence of ammonium nitrate, urea and N-methyl-urea of sodium nitrate, and N.N-dimethyl-urea and urea nitrate of potassium nitrate.

The marked difference in the deliquescence of the methyl ureas is of interest on account of the various structures suggested for these compounds[5].

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May 20.

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Examination of 'Egyptian Blue' by X-Ray Powder Photography

X-RAY powder photography has been carried out upon various examples of the brilliant azure pigment known as 'Egyptian Blue'. It has been found as early as the Fourth Dynasty (2900–2250 B.C.) and its use became very widespread throughout the Roman Empire. By this method crude frits from Tel-el-Yehoudi (Egypt), Silchester (Berkshire) and Woodeaton (Oxfordshire) have been shown to be of the same crystal form as a block already prepared for trading from Tel-el-Yehoudi, another in course of preparation from Armant (Egypt), and pale blue finely powdered pigment on pottery from Tel-el-Amarna (Egypt), and on wall plaster frescoes from Woodeaton. A potsherd from Woodeaton contained the same finely powdered pigment and was obviously used as a palette. All these examples were shown to contain essentially copper, calcium, and silica, with varying small amounts of sodium. Laurie and others[1] had previously shown that examples of a similar blue from Egypt, Rome, Knossos (Crete), Syria, and Wroxeter (Shropshire) consisted essentially of a definite compound—$CuO.CaO.4SiO_2$, which assumes this brilliant azure only if formed between 800° C. and 900° C.; outside these limits the frit passes to a green glassy mass.

The crude frits were found in the form of agglomerates of small balls about ½ in. in diameter, and this agrees remarkably well with Vitruvius's description (*c.* 24 B.C.) of the making of the pigment: "Caeruleum was first made at Alexandria, then by Vestorius at Puteoli. . . . Sand and Natron (native Soda) are powdered together as fine as flour and Copper is grated by coarse files over the mixture. This is made into balls by rolling in the hands. The dried balls are then put into an earthen jar, which is put into a furnace. When the Copper and Sand have coalesced in the intense heat and the separate things have disappeared, the colour Caeruleum is made." The biconical form of the balls, resulting from rolling in the hands, is especially noticeable in the examples studied.

The application of X-ray powder photography to the study of this pigment provides a simple means of establishing its identity, even in the finely powdered form as it appears in paintings; thus it was possible to identify copper aluminate, $CuAl_2O_4$, as being responsible for the blue colour on one pot from Tel-el-Amarna. It is hoped to extend the use of this method in the technological examination of antiquities.

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Attainment of the Upright Posture of Man

IN his recent paper entitled "Fifty Years Ago"[1], Sir Arthur Keith tells how, when in Siam in 1890, he became impressed by the similarity in muscular and visceral adaptations shown by the hand-swinging gibbon and bipedal orthograde man. The gibbon suspends its body in an upright posture by hanging from its hands; man maintains his upright posture

by standing on his feet. It was, therefore, an easy step to assume that the brachiating gibbon had paved the way to human uprightness. The story of this assumed transition is most graphically told in Sir Arthur Keith's little book "The Human Body", and it has become the creed of what W. K. Gregory of New York terms "the orthodox school". This brachiating hypothesis of the origin of man's upright attitude has been accepted by practically all English-speaking anthropologists and palæontologists. We may cite the Romanes Lecture of 1928 by Prof. D. M. S. Watson, the works of the late Sir Grafton Elliot Smith and many others in its support. This orthodox school, as represented by Gregory, claims that the brachiating habit is "a necessary introduction to the upright posture of Man", and man is defined by the same authority as "a made-over brachiator adapted to life on the ground" ("Man's Place among the Anthropoids", 1934).

This brachiating hypothesis of the origin of human uprightness I have had the temerity to contest for many years. In "Man's Place among the Mammals" (1929) I have set forth more fully the reasons that had made me reject the thesis in my first publication on the subject in 1916. In brief, I have always maintained: (1) that bodily uprightness was attained in the most primitive haplorrhine Primates long before the brachiating specialization of the anthropoid apes had been acquired; and (2) that as these primitive Primates showed the primitive condition of having the hind limb longer than the fore limb, it was, at least, unlikely that the human stock had ever become specialized as a brachiating form, with the fore limb longer than the hind limb (as is the case in all anthropoid apes) and afterwards reverted to the primitive condition of having the hind limb longer than the fore limb, as is the case in all known stages of the human phylum.

Perhaps I may be permitted to quote from Gregory, who has stated my views in his own language: "Professor Wood Jones has sought to depreciate the resemblances of the brachiating skeleton of the Gibbon to the upright bipedal skeleton of Man by claiming that the habit of brachiation has led to over-specialisation for arboreal life and has for ever prevented the anthropoids from entering upon the human path of evolution" (*op. cit.*, p. 17). This very fair statement of my views was made by Gregory in order to show how thoroughly biased and how completely erroneous they were. It is, therefore, of some interest to find that, towards the end of his latest paper, Sir Arthur Keith says: "I will add here two brief notes. (1) At that time I regarded the Gibbon as a representative of the pioneers of the orthograde stock and that Man and the great anthropoids had passed through a hylobation phase of evolution. It would take me too far afield to give the evidence which led me to abandon this opinion. Suffice it to say I now think that when the Gibbons were in their early stages of evolution (*probably in late oligocene times*) and developing along brachiating lines, two other modes of orthograde posture were also being evolved in the same stock. In one, both arms and legs were being used almost equally—the ancestral form of Gorilla and Chimpanzee; in a third—the ancestral human orthograde stock—the lower limbs were being developed as the chief organs of support and locomotion. All were arboreal in habitat". In this passage I have italicized one paragraph and will refrain from employing it as a direct negation of the views of the "orthodox school" and to Sir Arthur Keith's own published statements as to the period of divergence of the human stock from the phylum of the Catarrhini. Were I to be writing in the reminiscent strain of "Fifty Years Ago" I would record my satisfaction that Sir Arthur Keith and I (who was his student in 1897) are now in accord on this matter. If, as Sir Arthur postulates, the lower limbs of the human stock were becoming developed as organs of support and locomotion in "late oligocene times", it seems obvious that those adjustments regarding the position of the human stock in the phylum of the Primates, which I have long advocated, are no longer to be stigmatized as being unorthodox. One may indeed be permitted to wonder if those of the "orthodox school", deserted by the originator of the "brachiating hypothesis", will remain suspended by their hands or will descend to earth. In any event, their descent to earth will, like that of the existing anthropoid apes, indelibly bear witness to their apprenticeship of brachiating.

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Amer. J. Phys. Anthrop., **5**, 26 (March 30, 1940).

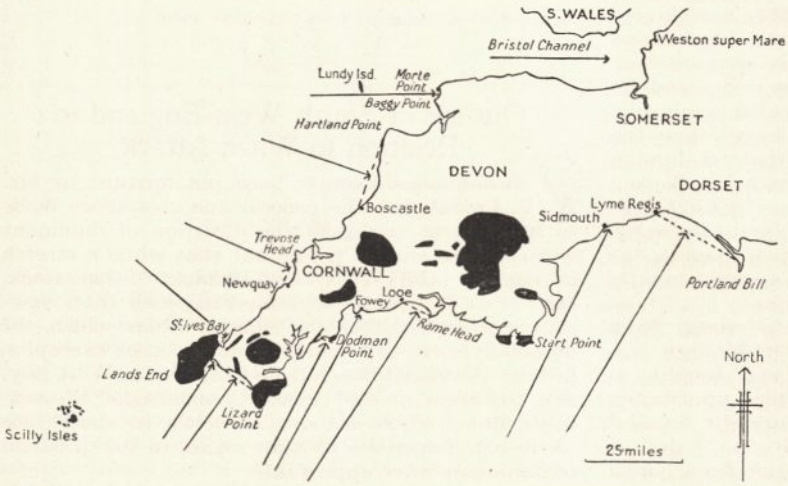
Outline of South-West England in Relation to Wave-Attack

A THEORY has recently been put forward by Mr. W. V. Lewis[1] that the general line of a shore tends to be at right angles to the direction of dominant wave-attack, and he points out that while a stretch of coast is in the process of adjustment to this attack, bays tend to become asymmetrical with the longer, smoother side facing the quarter from which the dominant waves approach. Among other examples, he cites the Chesil Beach from Chesilton to West Bay, and the coast of the Bristol Channel near Weston-super-Mare, where smooth stretches of shore face towards the open sea at right angles to the direction of dominant wave-approach.

It seems possible that this theory may be applicable to phenomena on an even larger scale, and that the major features of the coastal outline of Cornwall, Devon, west Dorset and west Somerset may be broadly interpreted on the same hypothesis. The south coast of the peninsula is divided into large bays by the headlands of the Land's End, Lizard Point, Dodman Point, Start Point and Portland Bill. In each of these bays, the western side (facing in a more or less easterly direction) is much indented into minor bays, divided by angular promontories, while the eastern side (facing south-west) is comparatively smooth, with blunted headlands. If, in each bay, a line (indicated by an arrow on the accompanying sketch-map) be drawn at right angles to the chord of the smoother eastern arc (shown by dots), it is found that its direction of approach to the coast is approximately from the south-west, and hence from the nearest part of the open Atlantic, clear of Cornwall and Brittany. The smoother eastern side of the bays therefore faces the dominant waves which approach from the nearest part of the open ocean.

In each bay, that deduced line of wave-approach from the south-west which passes the boundary-headland at a tangent is found to reach the coast at, or somewhat to the west of, the apex of the bay,

where the indented western stretch turns to the smoother eastern arc. This shows how the form of the bay is directly controlled by the superior resistance to erosion of the rocks of the major headlands (marked on the map in solid black). The Land's End is a granite mass, and the Lizard, Dodman and Start Points consist of Pre-Cambrian igneous or metamorphic rocks. The irregular western stretch is that which is protected by the major headland to the west of it, while the smoother eastern arc is that on which the waves can act directly. The stretches from Lyme Regis to Sidmouth, and from Looe to Fowey, between the apex of the bay to the east and the point to the west where the headland-tangent strikes the coast, may be regarded as not yet fully aligned by the wave-attack, and these stretches are likely, even when ultimately adjusted, to remain always more curved than the coast farther to the east, on account of the waves being deflected by the proximity of the boundary-headland. The coast between Start Point and Rame Head also remains at present irregular, since the drowning of the estuaries appears to be the primary factor controlling its outline.



SKETCH-MAP OF SOUTH-WEST ENGLAND; OUTCROPS OF IGNEOUS AND METAMORPHIC ROCKS IN SOLID BLACK. ARROWS INDICATE ASSUMED DIRECTIONS OF CONTROLLING WAVE-ATTACK.

A corresponding form of bay, with a smoother eastern arc and indented western stretch, is found also on the north coast of Cornwall and Devon. Here, as on the south coast, the dominant waves offshore presumably approach from the open Atlantic to the south-west, but their impact on the north coast is therefore oblique, so that it is not these waves which produce the maximum effect on the shoreline. The smoother eastern arc of St. Ives Bay, and the chords running from Trevose Head to Newquay, from Hartland Point to Boscastle, and from Morte Point to Baggy Point, face north of west or west, and probably it is from the open Atlantic in this direction, clear of Ireland, that the largest waves can approach approximately at right angles to the coast, and thereby model the shoreline. Between Morte Point and the area already described by Mr. Lewis near Weston-super-Mare, the general lie of the coast of the Bristol Channel is east and west, parallel to the direction of wave-attack and therefore relatively little affected by it.

I wish to thank Mr. W. V. Lewis for his helpful criticism of these suggestions, which are put forward tentatively as being at present only of rough application. I am hoping later to be able to make a more detailed study of the factors controlling the outline of south-west England.

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May 17.

[1] Summarized in Lewis, W. V., "The Evolution of Shoreline Curves", *Proc. Geol. Assoc.*, **49**, 107–127 (1938).

Vitamin-Free Diets for Animal Experiments

IN GREAT BRITAIN many workers on vitamins have used basal diets containing rice starch as the sole or predominant source of carbohydrate. In our laboratory that practice has been followed over many years for diets used in work on vitamin A, vitamin B_1, the rat 'filtrate factor', the 'eluate factor' (vitamin B_6) or vitamin E.

The difficulty of obtaining from our usual sources further supplies of rice starch after the outbreak of war led us to investigate the possibility of replacing it by wheat starch. We have found that this has in no way impaired the suitability of our diets used for work on vitamin A, vitamin B_1 or vitamin E.

Thus, 22 male and 10 female newly weaned Wistar albino rats, of the London strain, were fed upon our standard vitamin A-free diet, in which the change of starch had been made; all the animals reached a growth plateau in the usual time—25–31 days—and all animals receiving no supplementary vitamin A died within 40 days. Those animals that received, from the time of reaching a growth plateau, a twice-weekly dose of the International Standard Preparation of vitamin A, corresponding with daily intakes of 2 or 4 international units, responded normally. Of the 20 animals receiving no supplement, 14 developed xerophthalmia; of the 12 afterwards given vitamin A, 4 at some time showed signs of xerophthalmia, which disappeared before the experiment ended. These and other similar results are indistinguishable from those obtained with the diet containing rice starch.

Again, 65 animals receiving our vitamin E-free basal diet, in which the change of starch had been made, were positively mated to normal bucks: all underwent typical gestation-resorptions.

On the modified vitamin B_1-free basal diet, 32 males and 6 females ceased to show any increase in weight after 14–20 days. After 21 days administration of vitamin B_1 (crystalline aneurine chloride hydrochloride, 2·25 and 4·5 μgm. per day) 13 males and 1 female showed normal increases in weight. Of 6 males and 4 females receiving no supplement of vitamin B_1, 9 died between the thirty-eighth and the forty-seventh day of the experiment, most of them after a marked rapid decline in weight and

with external symptoms (vertigo) of avitaminosis-B_1. (One male survived a test period of 56 days without supplementary vitamins, showing no loss or gain on his starting weight.) Here again, replacement of rice starch by wheat starch produced no demonstrable effect.

We have, however, found wheat starch unsuitable for diets used in work on the rat 'filtrate factor'. Our animals never reach a true growth plateau on a filtrate-factor-free diet, but their weight-increase slows down to such an extent that statistically significant differences in weight-increases can be produced by supplements of filtrate factor in the ratio of 2 : 1, provided suitable response levels are chosen. This is an adequate basis for reasonably accurate vitamin assay. When, however, wheat starch replaces rice starch in our routine diet used for these tests, many of the animals show no slackening of growth after 4 weeks : discrimination between negative controls and animals receiving filtrate factor concentrate made from 32 gm. of fresh liver is seldom possible. With the rice starch-containing diet, groups of 3 animals are sufficient to detect the presence of such a concentrate in amounts made from only 8 gm. of liver. It would appear that the wheat starch we used had adsorbed or otherwise retained appreciable quantities of filtrate factor from the wheat berry.

We have no information about the effect of wheat starch on diets used for work on vitamin B_6 (adermin, 'eluate factor').

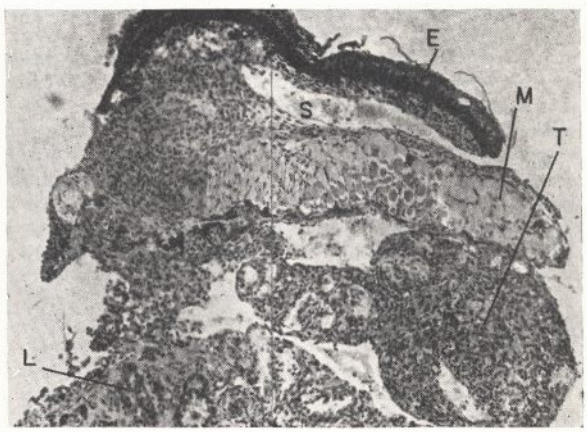
Glaxo Laboratories, Ltd., Greenford, Middlesex. June 4.

A. L. BACHARACH.

Tumour Induction in *Rana pipiens* Tadpoles

DURING the normal development of Amphibians the well-known 'fields' of organization operate to induce morphological differentiation[1]. Furthermore, adult Urodeles and larval Anurans are known to retain local fields which are active in the regeneration of parts[2]. Therefore, problems in abnormal growth may well be studied in those Amphibians which retain power of regeneration. One of the commonest present-day methods of experimentally producing abnormal growth is by means of carcinogenic substances, but apparently these substances have been little used for such studies in Amphibia. Recently, however, Koch, Schreiber and Schreiber[3] have induced tumours in adults of *Triton cristatis* and *Triton taeniatus* with 1 : 2 benzpyrene and with carcinogenic tar. The present report deals with induction experiments with *Rana pipiens* tadpoles using methylcholanthrene-choleic acid as the carcinogenic agent.

During February and March of 1939, 154 young tadpoles (20–30 mm. total length) were each injected subcutaneously near the base of the tail or behind the ear with about 0·2 mgm. of methylcholanthrene-choleic acid in crystalline form or in solution in lard. Healing occurred satisfactorily immediately after the operation, but during the subsequent three or four weeks the skin above the injected mass perforated and the carcinogen was lost in most cases. 94 control tadpoles were injected with lard alone or with paraffin. All animals were reared at room temperature (*c.* 22°). Eleven experimental and four control tadpoles died and were autopsied before metamorphosis ; they had developed no growths. All of the surviving animals were autopsied during June, July and August of 1939 at about the time of metamorphosis. Thirty-nine of the ninety-four control tadpoles had retained the lard or paraffin ; no growths were found. Of the original 154 experimental tadpoles only 12 retained the injected mass and in 3 of these subcutaneous tumours had developed in tissue surrounding the carcinogen. In two cases (*MC* 512 and *MC* 711) observed 95 and 158 days after injection respectively the tumour remained localized, forming a firm, non-pigmented mass of tissue about 2 mm. × 1 mm. × 0·5 mm. in size in hosts of about 22 mm. body length. In the third case (*MC* 62–119 days) the induced tumour showed signs of malignancy. From the injection site it had spread subcutaneously, penetrating the body wall musculature and invading the posterior part of the left lung. At the time of autopsy it covered an area of 5 mm. × 1·8 mm. and was 1 mm. to 1·5 mm. thick. This is a large tumour in proportion to the size of the host—a metamorphosing tadpole of 18 mm. body length.



TUMOUR INDUCTION IN *Rana pipiens* TADPOLES (× 61).

The accompanying photograph illustrates some of the structural features of this growth. From the original site of injection in the loose subcutaneous tissue (*S*), the tumour has grown outward, spreading along the base of the dermis (*E*). Growing in the opposite direction, it has penetrated the body wall musculature (*M*), expanded as a sizable mass in the coelom (*T*) and invaded the lung wall (*L*). Histologically it appears to be a connective tissue tumour of mixed cell type. Cells are spindle-shaped, round, or intermediate ; also they are quite variable in size. Generally the cells are closely packed and give no evidence of differentiation.

One of the two localized tumours (*MC* 711) presents the same histological picture as that described above for *MC* 62. The second localized tumour (*MC* 512) was transplanted subcutaneously to five tadpole hosts. Apparently the tumour tissue did not take in this small number of cases, for no abnormal growths have appeared in six months.

This work was supported by the International Cancer Research Foundation.

Department of Zoology, McGill University, Montreal. April 29.

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'Congenital' Copper Deposit in the Rat

THE striking increase in the copper concentration of the human liver, which begins during fœtal life and reaches its maximum at birth, has not yet been satisfactorily explained. Since the importance of copper as a catalyst for hæmoglobin formation is now conclusively proved for many higher animals, most authors consider the 'congenital copper deposit', too, to be connected with this function. Two hypotheses have been suggested in this respect: (*a*) copper is accumulated in the fœtal liver, because this is the chief site of blood formation during embryonic life; (*b*) copper is stored in the fœtal liver to compensate for the low copper content of milk during lactation, just as in the case of iron.

We have recently[1] raised some criticism against both views, which we see now supported by our new findings in the rat species.

Figures for liver copper in young animals are somewhat meagre. Cunningham[2] finds in seven species (bovine, sheep, pig, dog, guinea pig, rabbit and rat) similar conditions as in man, that is, highest values at birth and a rapid drop during the lactation period towards the low final level. Ramage[3], Wilkerson[4] and McFarlane and Milne[5], on the other hand, working with goat, pig and chick embryos respectively, observe the peak already during fœtal life and more or less low figures at birth.

During a study of iron, copper and hæmoglobin in white rats of various ages we were much surprised to find a marked increase of liver copper still after birth, the maximum not being reached before the 10–15th day of life (see accompanying table). Copper was determined by the dithiocarbamate method, non-hæmin iron by our hot pyrophosphate method[6], hæmoglobin spectro-colorimetrically.

The phenomenon occurred with great regularity in each of seven litters which had been followed from birth on during the first weeks of life; it contradicts the findings of Cunningham[2] who, however, has only examined one litter. The peak was always reached between the 10th and 15th day, nearly coinciding with the opening of the rat's eyes. It may be recalled here that the rat is born in a rather embryonic state of development, a fact which is also reflected in its red blood picture[7].

In contrast to the liver, the percentage of copper in the whole body was found to drop gradually from birth on, as already shown by Lindow *et al.*[8]

Histological examination, kindly carried out by Dr. H. Karplus, of some of the livers revealed no correlation between copper content and hæmopoietic activity of the liver; that was to be expected since this activity is highest during the early fœtal life—in birds and mammals—and has nearly disappeared at birth.

Our findings make hypothesis (*a*) untenable, and the same is true for the 'deposit' hypothesis (*b*), since the increase occurs just during lactation, and in spite of a general decrease in the body copper concentration.

It appears to us that the rather dramatic accumulation of copper, occurring in different species at different times and paralleled by a similar increase in the copper content of young rapid-growing plant tissues, is not associated with the process of hæmoglobin formation but with growth and development, a view already suggested previously[9,10,11]. We are not yet prepared to say what particular process may be connected with the increase of liver copper; but the recent identification of several oxidases as copper proteins and the isolation of similar compounds from blood and liver[12] open many possibilities in this respect.

A detailed report of our experiments will be published elsewhere.

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Age (days)	Liver-Copper		Liver-Iron		Hæmoglobin	
	Average	Range	Average	Range	Average	Range
0–1	97 (13)	62–133	1790 (16)	1180–2650	12·1 (60)	7·3–15·3
5–7	134 (6)	82–174	1245 (5)	650–2000	8·8 (6)	7·8–9·4
10–14	206 (7)	133–270	670 (6)	330–1130	10·9 (7)	9·5–11·8
15–17	124 (10)	54–204	340 (4)	137–500	—	
20–22			315 (9)	82–1240	10·4 (9)	8·0–13·4
32–44	33 (8)	21–50	620 (8)	450–895	*12·3 (5)	11·6–13·5

* 30–34 days.

Copper, non-hæmin iron (mgm. per kgm. dry weight) and hæmoglobin (gm. %) in young rats. (Figures in brackets indicate number of animals.)

Use of Desiccated Chick Embryo in Tissue Culture Technique

ONE of the difficulties inherent in tissue culture technique is the necessity for a regular supply of chick embryo extract, without which serial subcultures cannot be maintained. When fresh 9–11 day embryos are used, it is almost impossible to avoid a waste of material as it is necessary to incubate more eggs than will probably be required in order to ensure a sufficient supply of embryos.

At the commencement of the War, we decided to try desiccated 9–11 day chick embryos as a source of active principle, and, since November 1939, have successfully maintained a variety of cultures of normal and malignant tissues on fowl plasma clot, to which this extract was added. By parallel experiments, in which fresh embryo was compared with desiccated embryo, it was found that extracts of the two were equally effective. The desiccate was reconstituted by adding sterile distilled water up to the original volume. Aqueous extract prepared from such reconstituted material has better keeping qualities than fresh extract and can be used for ten days without apparent loss of efficacy.

In the dry state, the desiccate keeps without apparent loss of active principle for at least seven months; our desiccate has been kept in a refrigerator at 4° C., but this precaution may not be necessary. The desiccate can be prepared at short

notice, and may be regarded as a standard reagent.

The following tissues have been grown progressively by this technique: (1) normal 17-day chick embryo heart muscle, for four weeks; (2) normal 18-day chick embryo fibroblasts, for four weeks; (3) Jensen rat sarcoma, for five weeks; after which, re-inoculated cultures grew in rats; (4) fowl-grown Fujinami filterable sarcoma, for 4–6 weeks, after which re-inoculated cultures grew in fowls; (5) *GRCH*/15 non-filterable sarcoma, for 4–6 weeks, after which re-inoculated cultures grew in some fowls.

The economy in time and material that is rendered possible by this technique recommends it, particularly under war conditions, as it is possible to incubate sufficient eggs when they are plentiful and when fertility is high to maintain cultures throughout the rest of the year. Thus, it is unnecessary to maintain an egg incubator in constant service. By using the infertile eggs (removed after twenty-four hours incubation) for cooking purposes, waste of material can be completely eliminated.

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Vision and the Photochemistry of Visual Purple

VISUAL purple extracted from frog retinæ which is embedded in solid gelatine films ('artificial retina') reproduces on exposure to coloured light various phenomena of scotopic and photopic vision[1,2,3]. It is liable to 'general bleaching' or to 'colour selectivity' by photochemical processes. Both can be recorded by plotting the decrease of extinction against wave-length. If general bleaching occurs, the maximum of the graph (namely, at 530 mμ in the artificial retina) is independent of the spectral composition of the exposing light. In colour selectivity the maximum of the 'colour graph' coincides with the dominant wave-length of the coloured light for a normal trichromat. This forms the basis of an objective colorimetry[3].

The following conception accounts for the results obtained with the artificial retina[3]. Visual purple is a protein which is conjugated with a great number of caroteneic groups[4]. Its smooth absorption curve with a single maximum in the green is due to a mutual interaction of all the chromogenic groups. Monochromatic light of wave-length λ is supposed to produce an isomeric visual-purple-λ by a *cis-trans* transformation of a few double bonds[5]. After this change, the absorption curve of visual-purple-λ is still smooth with a slight decrease of extinction at λ, which accounts for the maximum of the colour graph at λ. Visual-purple-λ may be produced either by monochromatic light or by light of an appropriate spectral mixture. For example, visual-purple-589 may be formed by the *D*-lines, or by a mixture of monochromatic green and red, or by white light which has passed through a yellow filter, or a blue absorbing filter. By white light or by an appropriate mixture of various coloured lights (for example, complementary couples), visual purple is supposed to be decomposed into fragments, and general bleaching with its constant maximum at 530 mμ occurs. This also happens during a purely chemical after-effect in the dark. The two maxima of the colour graphs which are recorded in whitish coloured lights are therefore due to two different photochemical processes. Red light ($\lambda > 650$ mμ) decomposes visual purple on extended exposure and thus produces a secondary maximum of the colour graph at 530 mμ. Since the fragments are still colour selective from yellow to blue, it is probable that the original molecule is merely split into two parts. Extended exposure to blue light, on the other hand, is supposed to peel off photochemically the outer chromogenic groups of the molecule, leaving a residue which is found to be colour selective from red to green. The interpretation of the details of the experiments meets with no difficulties.

If the same processes occur in the living retina, it is obvious that vision is a chemical sense, with the sense of smell as its counterpart. The products of decomposition of the original visual purple stimulate the terminals of the optic nerve to produce a colourless sensation in scotopic vision, and a white sensation in photopic vision. The various isomeric visual-purple-λ stimulate coloured sensations with the dominant wave-length λ. Together with the products of decomposition they stimulate the mixed sensation of whitish hues. It is likely that colour blindness is due to a defect of the retinal tissues to build up the complete molecule of visual purple and that the synthesis does not proceed beyond the yellow-to-blue and red-to-green colour selective fragments.

From Hecht's experiments[6] it follows that the molecule of visual purple has the shape of a slightly oval particle. By assuming that the molecule is an ellipsoid with three unequal axes, the shortest axis would correspond to the strongest optical interaction of the chromogenic groups which makes them absorb red light. The longest axis would determine the absorption of blue, and the intermediate that of green light. The change of the molecule along these axes would stimulate the sensation of the three fundamental hues, and this conception would link the 'three-component' theory of colour vision with our photochemical hypothesis, which postulates an equivalence of all distinguishable hues.

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May 28.

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Species Variation in the Insulin Content of Pancreas

ALTHOUGH the administration of a diabetogenic anterior pituitary extract diminishes the insulin content of the pancreas of the dog[1], treatment with a similar extract increases the amount of insulin to be found in the pancreas of the rat[2]. In the course of an investigation into the influence of pituitary extract on the pancreatic insulin content of different species, we have observed substantial differences in the amount of insulin found in the pancreas of normal members of a number of species (see accompanying table). In particular, as the data in the table show, the insulin content of the normal guinea pig pancreas is very much lower than that of any of the other species we have examined, a result which was somewhat unexpected in view of the well-defined β cells to be found in the pancreatic islets of this species. These β cells contain chromaphil cytoplasmic granules which

INSULIN CONTENT OF PANCREAS OF DIFFERENT SPECIES.

Species	Weight of pancreas (gm./100 gm. body weight)	Insulin content of pancreas	
		Units/gm. pancreas	Units/100 gm. body weight
Chimpanzee	0·09	11·2	1·01
Dog	0·23	3·3	0·76
Cat	0·21	2·2[4]	0·47[4]
Rabbit	0·15 0·13	9·5 7·8[5]	1·42 1·17[5]
Guinea pig	0·37 0·31	0·08 0·23[5]	0·028 0·070[5]
Rat	0·48	1·3	0·62
Mouse	1·10	1·7	1·87

(Methods are those of Marks and Young (1939) unless otherwise indicated.)

are influenced by the blood sugar-level[3] and appear to be associated with the insulin-secreting mechanism.

When insulin was dissolved in an extract of guinea pig pancreas, only about 50 per cent of the expected activity could be found in the biological assay (mouse test), although the apparent activity of the insulin was not reduced if an acid aqueous solution of insulin was injected into one side of the mouse while the extract of guinea pig pancreas was simultaneously injected into the other. Substances in the extract therefore appear to interfere with the absorption of insulin from the subcutaneous tissues; but it is improbable that such an effect could entirely account for the fact that guinea pig pancreas appears to contain only about 1/15 the amount of insulin found in the pancreas of the rat.

Preliminary experiments have shown that the mouse resembles the rat in exhibiting a rise of pancreatic insulin content as the result of treatment with crude ox anterior pituitary extract, whereas the rabbit pancreas, like that of the dog, exhibits a fall in insulin content under similar conditions. With the rabbit, however, the fall was not so great as with the dog, a fact in keeping with the less consistent response of the rabbit to the diabetogenic action of a crude anterior lobe extract[6].

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Concentrated Plasma in Histamine Shock

Best and Solandt[1] recently reported that the intravenous injection of pituitrin and concentrated serum produces beneficial effects on blood-pressure in dogs suffering from traumatic shock or histamine poisoning. We have studied the effects of various fluids in thirty cats injected with 5 mgm. of histamine per kgm., which in control experiments produces death within two hours. Animals receiving intravenously 10–25 c.c. per kgm. of concentrated plasma (concentrated to one half or one third its original volume) within ten minutes of the histamine injection survived for more than four hours and the blood pressure usually recovered to about normal level. Intravenous saline was ineffective. Normal plasma or gum-saline were also less satisfactory, generally producing only a short-lived rise of blood pressure. The administration of concentrated plasma may thus be of value in patients suffering from severe traumatic shock or other conditions associated with markedly increased capillary permeability.

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Prevention of Seedling Blight in the Flax Crop

SEEDLING blight, caused by *Colletotrichum Lini* (Westerd.) Toch., is a disease of flax which is likely to assume greater importance should the cultivation of flax and the home-saving of seed become more widely and intensively practised. The parasite is seed-borne and damage caused by it to the crop would be largely prevented if a satisfactory method of seed disinfection, whereby the parasite is killed and the germination of the seed unimpaired, could be found.

In view of the possibility of seed-borne diseases of flax becoming of greater import, the problem of their prevention has occupied the attention of the Plant Disease Division of the Northern Ireland Ministry of Agriculture for the past two years. During this time rapid and accurate technique has been evolved for the examination of flax seed samples for seed-borne parasites, and a sorting test has been devised for the rapid discrimination between likely and unlikely seed dressings applied for the purpose of parasite extermination.

During the summer of 1939 a large number of chemical dressings were examined by the sorting test for the purpose of determining their efficiency, and among a range of materials submitted by the Imperial Chemical Industries, Ltd., an experimental product styled *R.D.* 7846 and containing tetramethylthiuram disulphide as its active constituent gave very promising results. One very pleasing feature of this product is that it is apparently non-poisonous. It is in the form of a finely divided powder and gave satisfactory results when applied to the seed at the rate of 3 gm. per 500 gm. (approximately 5 oz. per bushel of 54–56 lb.).

More extensive trials with the use of this material have been planned for 1940, and from preliminary results in the field which have already been obtained, the promise shown by the laboratory tests has been upheld. So far no phytocidal effects have been observed in the crops and the attack of seedling blight has been reduced to negligible proportions.

This statement should be regarded as of a preliminary nature and it merely records the possibility of *R.D.* 7846 being a suitable flax seed dressing for the prevention of seedling blight. It is not suggested that this fungicide is the most suitable for the prevention of other or all seed-borne diseases of flax, but owing to the possibility of the growing importance of seedling blight it is felt that this observation merits serious attention, especially at the present time.

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RESEARCH ITEMS

Abnormalities of Speech and the Development of Language

A TENTATIVE classification of abnormalities of speech observed in children and defectives has been put forward by Leopold Stein, speech therapist of the Tavistock Clinic, London (*Brit. Med. J.*, June 1, 1940). In a baby of any race the first sounds observed are cries which correspond solely to emotional states of mind (fear, cold, hunger, etc.). These are at first mere reflex activities, and it is difficult to decide if they are articulate or not. As reflex activities, however, they represent a step in the recapitulation of phylogenetic development (animals' cries). Between the second and fifth week the primitive squall begins to be differentiated, among its special forms being the glottal stop, a primitive and very ancient symbolization related to all negative emotions such as fear, evinced, for example, in an advanced stage of stammering. Further, all children show a certain preference for nasal resonance in song and speech, like primitive peoples. In the babbling period there appears from about six months the so-called primitive sounds, the "Urlaute" (Russmaul, 1877), which it is assumed first appeared among mankind and from which developed the languages of to-day. It is richer in sounds than is required in after-life, while another characteristic is lallation, that is, the reiteration of syllables. They are not at first purposive, but become so. By comparison with a primitive language such as Hottentot, especially as regards primitive sounds such as 'clicks', and repetitions, this period appears also to be a recapitulation of one of the earliest phylogenetic periods of linguistic evolution. Next follows the period of linguistic babbling, when the child attempts to express wishes and ideas by imitation of the sound symbols of his surroundings, and when it has to adopt group modes of behaviour in this respect. The articulatory movements of the growing individual become canalized and conventionalized in the standard speech. In the study of abnormalities a child may develop idioglossia, that is, a language of its own; this is not a gibberish, but is found on study to be subject to certain laws of sound-changes, which may easily be compared with the phonetic changes in the historical development of languages.

Body Build

PROF. RAYMOND PEARL in seeking a formula for an index of body build (*Amer. J. Phys. Anthrop.*, **26**, March 1940) points out that the importance of body build or bodily habitus in appraising the general biological constitution of the individual has long been recognized, more especially ever since Kretschmer (1925) emphatically and persistently directed attention to the correlations between habit of body and psychological and temperamental characteristics. A variety of proposals for a measure of bodily habitus has been made but none is completely ideal, since the human body is from a geometrical point of view a solid of an extremely complex shape, which it is difficult to express adequately by any simple numerical statement or formula. The biological root of the difficulty lies in the fact that changes in the size of the body from the pre-natal period to advancing age occur in all three of the fundamental reference planes of the body, length, breadth and thickness. Further correlation is low in degree and irregular. After surveying the various proposals and reviewing the desiderata, it is suggested that a bodily habitus index in use in the author's laboratory would seem to meet fairly most of the requirements. The formula in its most general form is: Habitus Index $= \frac{100\ (\text{chest girth} + \text{abdominal girth})}{\text{stature}}$. It is evident that the values of the index increase as we pass from extreme asthenic individuals, tall and 'skinny', who will have the lowest indexes, to the extreme pyknic individuals, short and stout, who will have the highest indexes. Secondly, the index is dimensionally homogeneous, involving only linear measurements. Further, all three of the dimensions are definitely located and are biologically significant. By actual trial on observed material this index proves to reflect in a sensitive manner differences between individuals in body build, and in the same individual differences consequent upon changes in body build with advancing age.

Insect Fauna of a Hornbill's Nest

IN the *Entomologists' Monthly Magazine* of May 1940, E. B. Britton, of the Department of Entomology, British Museum (Natural History), discusses the insects sent to him by R. E. Morgan from a nest of the silvery cheeked hornbill (*Bycanistes cristatus* Rüpp) at Amani, Tanganyika. Altogether some 438 individual insects were sent from the rotten wood forming the walls of the nest hole. There was no obvious dung or food debris present. The insects included 86 adults and 37 nymphs of the plant bug *Chilocoris laevicollis* (Fam. Cydnidæ). No explanation of the member of a phytophagus family breeding in the nest can be offered. Beetles of the family Carabidæ were represented by two examples of *Oecornis nidicola* gen. et sp. nov. and 15 larvæ possibly of the same species: 15 elaterid larvæ also occurred and 35 larvæ of a species of, or near to, Alphitobius (Tenebrionidæ). Lepidoptera was represented by 201 larvæ of the family Coleophoridæ. Also, there were 43 nymphs of a new species of Blattidæ and four acalypterate fly larvæ. It is noteworthy that at least seven of the eight species found in the nest were breeding there, and it is concluded that the thoroughly sanitary state of the nest must owe much to their scavenging activities.

Echinoderms from the John Murray Expedition

Two recent reports deal with the Regular Echinoidea and the Ophiuroidea respectively (John Murray Expedition 1933–34, *Sci. Rep.*, **6**, No. 1. "Report on the Echinoidea of the Murray Expedition", Part 1. By Th. Mortensen; and **6**, No. 2. "Ophiuroidea". By Hubert Lyman Clark. British Museum (Natural History), 1939). There are 35 species of regular Echinoidea collected by the Expedition, less than those obtained by the *Investigator* (50 species), but with regard to the Cidarids it has done even better, for out of 12 species, 5 are new, one representing a new genus. Moreover, two of these, *Cidaris mabahissæ* and *Lissocidaris fusca*, are of great zoo-geographical

interest as they belong to the sub-family Cidarina, hitherto only known from the Atlantic. *Goniocidaris indica* is also a very interesting discovery as the genus, so richly developed in the Japanese-Malayan-Australian region, is not otherwise represented in the Indian Ocean. A discussion of the zoo-geographical problems will be included in Part 2 of this report. The Ophiuroids form a splendid collection from the North West Indian Ocean. It is very rich in genera and species, there being six new genera out of 42 obtained and out of 102 species one third are new. All are very distinct forms. The numerous illustrations are very clearly drawn and show the essential features. From the study of the *Mabahiss* material it is shown that the ophiuran fauna of the Arabian Sea and adjoining coasts has undoubtedly originated from the East Indian Region but has not yet developed nearly so rich a littoral group and there is a markedly large proportion of endemic species.

Garden Plants of the Future

MANY plants of potential garden beauty lie in static conservation within herbaria. F. Kingdon Ward, though himself responsible for numerous exsiccata, has made a survey of such conservatories in order to discover horticulturally deserving plants which have not yet been aligned with garden practice. A few of these have recently been described (*Roy. Hort. Soc. J.*, **65**, Pt. 5; May 1940). *Vaccinium modestum*, *Laccopetalum giganteum*, *Arctomecon californicum*, two species of *Veronica*, *Rhododendron Devriesianum*, *Gentiana setulifolia* and *Limonium insigne* are but a few botanical examples of world-wide origin, which have not yet enjoyed the care of the cultivator. Captain Kingdon Ward's descriptions, however, show that gardens would indeed benefit from their introduction, and this experimental invasion of 'botanical mausoleums' might well be extended.

Apomixis in Crepis

G. L. Stebbins and E. B. Babcock (*J. Hered.*, **30**, 519–529; 1940) and G. L. Stebbins and J. A. Jenkins (*Genetica*, **21**, 191–224; 1939) describe the behaviour of several North American species of Crepis. These species are polymorphic, have variable and high chromosome numbers, and are apomictic. Within the group of species studied, only seven were diploid and sexual and considerably restricted in geographic range. The polyploid forms either simulate the diploid form very closely, and are presumed to be auto-polyploids, or combine the characteristics of two or more diploid forms. The apomictic forms are either obligate or facultative, and reproduce by somatic apospory followed by parthenogenesis as in Hieracium (Rosenberg). The origin and spread of the polyploid forms are described. It is suggested that apomixis accompanies hybridization and polyploidy, but is not caused by either. The origin of apomixis is suggested to be related to genetical or factorial causes. The apomictic forms sometimes produce progeny by sexual means, and thus secondary types are evolved. As these authors and Banta (*Proc. Gen. Soc. Amer.*, 1939) point out, the apomictic-amphimictic life-cycle greatly favours the rapid spread of variants. Hence it is found that there is great polymorphism as one leaves the region of the diploid progenitors. Occasional crossing between an allo-polyploid and a third diploid species will also increase the variation.

Male Sterility in Hebe

IN a population of 2,200 plants of *Hebe traversi* at Cass, New Zealand, 3·5 per cent of the plants were found to be pollen sterile. O. H. Frankel (*J. Genet.*, **40**, 170–184; 1940) also found wild plants of other species of Hebe to be pollen sterile. Cytological study showed that the chromosomes of male sterile *H. parviflora* and *H. subalpina* collapse into an amorphous mass following pachytene. In *H. salicifolia* var. *communis* all stages are normal until telophase II, but no tetrads were seen. In *H. leiophylla* × *H. salicifolia* and in *H. traversi* pollen grains degenerate very soon after formation and before the cell walls thicken, whilst in *H. Townsoni* an upset of timing of meiosis in the anther is present together with signs of collapse of the pollen grains. It is suggested that some major physiological disturbance affects the loculus at a time characteristic of the particular male sterile form.

Irregular Flowers in Phlox

J. P. KELLY (*J. Hered.*, **31**, 169–171; 1940) bred from an individual of Phlox the flowers of which lacked one or more petals. The characteristic was inherited, but great fluctuation in the proportion of irregular flowers was found. In an F_1 hybrid between regular and irregular flowered plants, 147 were regular and 10 slightly irregular. The F_2 segregated 808 regular: 197 irregular. Other data show that the fluctuation in irregularity is environmental in origin.

Core Disease in the Apple

H. P. BELL has published an interesting note on the susceptibility of the Gravenstein apple to core disease (*Canadian J. Res.*, **18**, No. 3; 1940). Harrison has previously suggested that the "constitutional weakness of the calyx end" was responsible for the prevalence of this trouble in the variety, and Prof. Bell's observations confirm this suggestion. The carpellary cavities are usually closed from the stylar cavities by solid tissue in the intervening region, which might be described as at the upper level of the calyx tube. In the Gravenstein, however, cavities in the radial stylar extensions continue to penetrate very deeply into this tissue, much more deeply than in other varieties studied. Thus this tissue organization is structurally weaker at this calyx end of the apple, and radial fissures may easily develop and facilitate the entry of disease to the carpellary core.

Radio Echoes and Fading

J. A. Pierce and H. R. Mimno (*Phys. Rev.*, **57**, 95) point out that the records of signals reflected vertically by the ionosphere sometimes show an anomalous distribution of intensity among the successive reflections; for example, highly multiple reflections may be as strong as, or stronger than, the first two or three reflections. This condition may persist for ten minutes or so at a time, and the authors explain it by supposing that the ionospheric layers show local curvature which focusses the waves on the receiver after a certain number of reflections. These effects are only observed when transmitter and receiver are close together, and have no effects in normal radio communication. It is probable, however, that focussing by reason of changes of curvature in the F layer may affect communication over distances comparable with the radii of curvature, of the order of thousands of kilometres, and the authors discuss cases of slow cyclic fading in trans-Atlantic short-wave signalling

which may be explained in this way. Sunrise must be associated with considerable slope and curvature of the surface of the ionospheric layers, and in fact the focussing phenomena have been observed at this time. A mechanism is indicated which leads to the reflection of rays back to the transmitter by a complicated path at such a region of curvature, and may lead to the production of echoes of very long delay of the order 0·1 sec. A similar suggestion of local irregularities was put forward some years ago by G. R. Toshniwal, B. D. Pant, R. R. Bajpai and B. K. Verma (*Proc. Nat. Acad. Sci., India*, **6**, 161 ; 1936).

Field Produced by a Linear Radiator

A PAPER by F. M. Colebrook, of the National Physical Laboratory, has been communicated to the Institution of Electrical Engineers (*Journal*, Feb. 1940), on the electric and magnetic fields of a linear radiator carrying a progressive wave. The vector- and scalar-potential method of calculating electric and magnetic fields is applied to a straight conductor carrying a progressive wave of current. The author proves that unless the conductor is assumed to be terminated by charges which satisfy the condition of electrical continuity at the ends, the calculated field has an anomalous and impossible character. Such charges need not be included in the case of closed circuits of conductors carrying progressive waves. He confirms this by analysing in a special case the mutual cancellation of the anomalous features. It is pointed out that a linear progressive wave radiator has only one axis of symmetry, which is that of the radiator itself. This differs from a standing wave radiator which is symmetrical about the equatorial plane. Analysis thus confirms the asymmetry of the field from a progressive wave radiator. The field system associated with a progressive wave of current is regarded as a more fundamental conception than that due to a standing wave, since any standing wave system of currents is resolvable into positive and negative travelling waves. This feature is illustrated by the synthesis of the travelling wave fields into the known form for a dipole standing wave radiator. The radiation resistance of a progressive wave radiator is calculated by Pistolkoro's method, and is shown to be equal to that for a standing wave radiator when the length of the radiator is an integral number of half wave-lengths.

Electron Microscope

THE RCA Manufacturing Co., Camden, N.J., U.S.A., announces the production of a new electron microscope developed in their research laboratories by Drs. L. Marton and V. K. Zworykin. The instrument, like that described by Martin, Whelpton and Parnum (*J. Sci. Inst.*, **14**, 14 ; 1937), employs three magnetic lenses, the optical equivalents of a condenser, objective and projector. The intermediate, or first-stage image, is produced by the objective at a magnification of 100 diameters. This image is subjected to a further magnification of 250 by the projector lens, which throws the final image at a magnification of 25,000 on to a fluorescent screen for direct observation or on to a photographic plate. The quality of the photographic record of the final image is such that a further optical enlargement of 4 diameters may be used, giving a total overall useful magnification of 100,000 diameters. The technique of preparing specimens for examination has been carried to a stage where the instrument is ready for use in a research laboratory. Examples of the application of a similar instrument to biological investigation have recently been given by von Ardenne (*Naturwiss.*, **8**, 113–127 ; Feb. 23, 1940) who has photographed such objects as diatoms, viruses and bacteria at magnifications up to 100,000. The development of the instrument has opened up a new field to direct observation hitherto far beyond the resolving power of the optical microscope. The size and shape of smoke particles and the changes during the reaction of small particles with a gas are susceptible to direct visual observation. The use of the instrument promises to yield much new knowledge about particles of colloidal dimensions.

Energy of Gaseous Molecules

THE calculation of the fraction of the molecules in a gas which possess energy above a specified amount is simple when motion in only two directions is considered but becomes difficult when three directions are considered. Hence in many cases the simple form for motion in two dimensions has been used in cases where three dimensions are involved. A. H. Heatley (*Canadian J. Research*, **18**, 123 ; 1940) has given a table of a function from which the ratio, v, of the fraction N_1/N (N is total number of molecules, N_1 is number of molecules possessing energy greater than E for the two-dimensional case ($N_1/N = e^{-E/RT}$) to the ratio for the three-dimensional case) can be calculated. This ratio is equal to $[2x^2 + L(x)]/x\pi^{1/2}$ where $x^2 = E/RT$ and $L(x)$ is a tabulated function, the relations of which to the error function complement and other functions are given. It is shown that the ratio v changes rather slowly as E/RT changes :

E/RT	0	1	4	9	16	25	36	49
v	1·00	1·56	2·51	3·56	4·65	5·73	6·86	7·98

Properties of 3 : 6-Anhydrogalactose

THE transformation of an α-methylglycoside or a β-methylglycoside into an equilibrium mixture of the two forms may be effected by means of methyl-alcoholic hydrogen chloride, and it is usually accepted that this transformation involves the intermediate formation of the free sugar. W. N. Haworth, J. Jackson and F. Smith (*J. Chem. Soc.*, 620 ; 1940) have now described the syntheses of 3 : 6-anhydro-α and β-methylgalactopyranosides and various methylated derivatives. Liquid 2 : 4-dimethyl 3 : 6-anhydro-α-methylgalactopyranoside can be directly transformed into crystalline 2 : 4-dimethyl 3 : 6-anhydro-β-methylgalactopyranoside by small amounts of hydrogen chloride in air, hydrogen bromide in air, ethereal hydrogen chloride, ethyl-alcoholic hydrogen chloride and methyl-alcoholic hydrogen chloride. The direct isomerization of α to β also occurs spontaneously when the α-form is kept for several months. None of these methods appears to involve the intermediate formation of a free reducing group. With excess of methyl-alcoholic hydrogen chloride both the α- and β-form of 2 : 4-dimethyl 3 : 6-anhydromethyl-galactopyranoside, which have strained structures, yield the relatively strainless 2 : 4-dimethyl 3 : 6-anhydrogalactose dimethylacetal. Hydrogen chloride or hydrogen bromide effects the removal from this of the elements of methyl alcohol, and 2 : 4-dimethyl 3 : 6-anhydro-β-methylgalactopyranoside is produced. It is suggested that the steric effect of the stable 5-membered 3 : 6-anhydro-ring is responsible for some of the peculiar properties of 3 : 6-anhydro-galactose and its derivatives.

AGEING OF POPULATIONS

PROF. RAYMOND PEARL'S presidential address at the centenary celebrations of the American Statistical Association on December 29, 1939 (*J. Amer. Statist. Assoc.*, **35**, 2; 1940), points out that populations indubitably age with time, and as a relevant example compares certain aspects of the population of the United States one hundred years ago and the population of to-day in those areas which formed part of the States one hundred years ago.

Notwithstanding the partiality of poets and other writers for the seven stages of man's life, biologically the life-cycle of any mammal falls into three stages, and three stages only, which have epistemonic significance. These are pre-reproductive, reproductive, and post-reproductive. In man the pre-reproductive stage includes infancy and the major part of growth. The reproductive phase is *also* the period of full vigour in all the manifold ways that the human engine uses to let off steam. The post-reproductive phase is *also* the period of senescence, and of the ripened wisdom that only the experience of living a long time can bring. Mostly these matters biologically are *also* secondary to the basic business of life; one of them, however, is of first-rate importance, especially in the human animal, namely, that people in the reproductive phase have to do the work not only to get their own livings, but also the livings of the young and the major part of the livings of the old in the post-reproductive phase. This puts a heavy burden of work on the shoulders of a moiety of every human population that we know anything about.

From this consideration arises a threefold age classification of 0–14 years, 15–49 years, and 50 years and above, allocating the population in substantial accord with the fundamental biological divisions of each individual human being's life-cycle from birth to death. About 50 per cent of all populations, it has been noted, fall into the 15–49 class, but in the other two classes the numbers vary more widely and in a compensatory way. Thus a population like that of India in 1931 had 39·9 per cent in the pre-reproductive phase, 50·4 per cent in the reproductive phase, and only 9·7 per cent in the post-reproductive phase. In the same year, by way of contrast, the population of France had only 22·9 per cent in the pre-reproductive phase, about 51·4 in the reproductive phase, and almost three times as great a proportion, 25·7 per cent, in the post-reproductive phase. Biologically the two populations are deeply differentiated.

It is clear that the status of any population at a given moment relative to the proportions of its component members, falling in the three biological phases of the life-cycle, may have an important and direct bearing upon the aggregate or composite behaviour of that population and upon the probable course and outcome of any enterprises upon which it may embark as a whole. Of all the forms of aggregate behaviour in which a population may become involved, war is one of the most significant as well as dreadful. Comparing the populations of the chief protagonists in World War I of 1914 and World War II of 1939, taking Germany and Austria in 1914 as opposed to France, England and Wales, Scotland and Belgium, but omitting Russia for certain reasons, as well as outlying parts of the British Empire, on the figures of 1910–11, Germany and Austria had resources of upwards of 64 million persons, of whom approximately 33·5 per cent were in the pre-reproductive phase, 50·8 workers of the reproductive phase, upon whom fell the burden of fighting and producing goods for the troops and civilian population, and 15·7 were over 50 years of age; or taking male population only, 34·1 per cent, 51·3 per cent and 14·7 per cent respectively. Among the Allies the corresponding figures were a total population of 87·5 millions, of whom 52·2 per cent fell in the fighter-worker class, representing an actual advantage of nearly 3 million persons. In the under 15 phase were 28·5 per cent, and over 50 years about 19·3 per cent. Taking male population only the Allies numbered upwards of 48 millions against 32 millions for Germany and Austria, a relative advantage of 34 per cent. Of its components 52·4 per cent fell in the fighter-worker phase as against 51·3 in the German controlled population resources.

At the outbreak of World War II, the Allies had total population resources of both sexes of 87 million persons, of whom more than one quarter (as against 19 per cent in 1914) were of post-reproductive age. Further, instead of 52·2 per cent of fighter-workers, there are only 51·3 per cent in this phase. Finally, instead of 28·5 per cent of youngsters coming of age there are only 23·6 per cent.

The population resources controlled by Germany (including Czechoslovakia) in September 1939 present a different picture. She has a total of approximately 90 millions to draw upon. Of its component members 53·7 per cent, as against the Allies 51·3 per cent, were in the fighter-worker phase, representing an advantage of more than 3·6 millions of persons, of whom a little fewer than half are males, while there are only 22·4 semi-dependent old folks as against the Allies 25·2 per cent, while of youngsters there are 23·8 as against the Allies 23·6 per cent. It is plain that so far as the population aspects of war are concerned, the absolute and relative advantages and disadvantages accruing from that source have become reversed in the quarter of a century separating these two great conflicts. Falling birth-rates on one side and rising birth-rates on the other have been in the main responsible.

Prof. Pearl went on to analyse in similar manner the white population statistics for thirty political subdivisions of the United States in 1840 and 1940, and arrived at the main conclusion that while the old folks on one hand and the youngsters on the other are "ganging up" on the half of the population that does the work, pays the bills and taxes, and in cold fact earns the living for all, whereas in 1840 each 1,000 workers had 1,084 other persons, younger and older, to take care of, in 1930 each 1,000 of the 44,134,796 workers supported only 880 persons besides themselves. Biologically this appears to be a striking example of *adaptation* of the human species, *qua* species. The current use of such devices as contraception (or, for that matter, capitalism or communism) as adaptive procedures to ease the burden of ageing populations may in the long run be the moral equivalent of curing a toothache by the effective but disastrous technique of cutting off the patient's head. It is no good making life easier if there is no one to live it.

IRRIGATION RESEARCH IN THE PUNJAB

A MODERN aspect of irrigation has been given prominence by the recent publication of the report of the Punjab Irrigation Research Institute for the year ending April 1938.*

The report is a record of considerable activity and success in dealing with the great direct and indirect problems associated with the large-scale irrigation of an alluvial countryside. During the year there were added to the facilities of the Institute a new Hydraulic Laboratory and a River Research Station at Malikpur, but even with these the pressure of the demand is unabated, for the growing recognition of the importance of soil studies has resulted in an increased volume of work.

The staff of the Institute is divided into seven different sections to deal with the several classes into which its work may be assorted. In the Chemical Section, perhaps the most important investigation was that on the reduction by chemical means of seepage losses from canals, which has now reached the field stage. Here the result of treating the bed of the Awagat Distributary with a lining of soil impregnated with sodium chloride was to reduce the seepage by 2·3 cusecs, and this at a cost which it is calculated will be paid for by the additional revenue from the water saved over a period of three years. This Section has also been investigating the movement of salts in the soil profile, which in the Punjab alluvium consists of a shallow soil crust overlying sand. With a rising water-table the salts move towards the surface and form an accumulation ; from intensive examination of a small area it was determined that there is no lateral movement of the salts and their rise at any point depends mainly on local characteristics and on the factors causing the rise. The work in the standardization of methods has resulted in a simple procedure for estimating total sulphides in soils and irrigation waters and in the determination of the isohydric *p*H value of soils, both of which are explained in the report.

* Punjab Irrigation Research Institute. Report for the Year ending April 1938. Pp. vii+156+84 pl. (Lahore.)

The chief study which has engaged the Physics Section was one on tube wells in model, and was directed towards determining the factors which influence discharge. The conclusions pointed to are threefold, it being found that, subject to certain provisos, the yield is generally proportional to the draw-down and increases very slowly with increase in the diameter of the strainer, while it can also be increased by shrouding. Other investigations in this Section were concerned with the problem of seepage from canals, with the transmission constant of sands and with silt in relation to regime conditions. Experiments were begun in the Laboratory to examine the capillary rise in soils, and particulars of the method and apparatus in use are given.

Relationships between the bed silt and the hydraulic elements of channels have been investigated by the Statistical Section, and the empirical results obtained have already been found useful in the running of old channels and the design of new ones. Although they are not put forward as of general application, the suggestion is made that they should be tested on canal systems outside the Punjab. The most important work of the Hydraulic Section was provided by the Haveli Project in the reconditioning of works and river training operations. Laboratory investigations were made in order to get a design for the Trummu Weir which would give maximum coefficient of discharge, and the falls to be constructed on the canals have been exhaustively studied.

At the River Research Station at Malikpur a model was made of the Rivers Chenab and Jhelum at their confluence, and the work done on this has led to precautions being taken which will reduce to a minimum difficulties which have been met in earlier constructions of this nature. An interesting point arising from the Land Reclamation Section's report is the tendency of cotton land to deteriorate, while that irrigated for rice gives a more permanent form of reclamation.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

IN the account of the Congress of the South-Eastern Union of Scientific Societies held at St. Albans last year, printed in NATURE of July 8, 1939, it was suggested that this year the usual five-day Congress might be held in Cambridge and, as supplementary to the main annual Congress, single-day meetings might also be arranged to help local societies in centres too small to justify selection as a meeting place. The effect of war conditions, however, has ruled out Cambridge for the present. Following the precedents set in 1917 and 1918, therefore, for general convenience the abbreviated Congress was held in the rooms of the Linnean Society in London on June 12.

In the morning the Sections held their business meetings, independently, each being followed by an address and discussion. The addresses will appear later in an abbreviated volume of the *South-Eastern Naturalist and Antiquary* (vol. 45) and were as follows : archæological address on "Medieval Towns" by Mr. G. E. Chambers ; botanical address on "Seaweeds and their Uses" by Dr. E. M. Delf ; geological address on "Hints on Geological Mapping" by Dr. R. L. Sherlock ; and, in the afternoon, zoological address on "Waterfowl" by Mr. D. Seth-Smith.

The new president of the Union, Dr. R. R. Marett, Rector of Exeter College, Oxford, delivered his address on "Realism and Idealism in the Study of Man". Anyone who has read Prof. H. L. Hawkins's 1938 Alexander Pedler lecture on "Humanity in Geological Perspective", given at the Worthing Congress, will recognize that both treat of the same general theme,

but from different angles, and arrive at the same conclusions. Dr. Marett's main point was that a philosophy and a science of man must come to terms; in other words, that any doctrine of human perfectibility should have regard for man's place in Nature as the anthropologist seeks to determine it. The conditions of survival must be observed if a given people, or the race as a whole, is not to be improved clean off this planet.

True, the human species for the moment enjoys a biological dominance scarcely challenged unless it be by the bacteria; so that man's greatest foe is, roundly speaking, himself. Even so, it would not take the race long to breed up to the extreme limit of bare sustenance; and to-day those who desire not merely to live but to live well, in short, the representatives of the higher culture, are elbowing entire peoples of backward culture out of existence. A survey of the world's potential food supply shows that mankind has already exhausted much of its heritage by failure to attend to the principles of soil conservation; nor can all the brilliancy of city life atone for neglect of the land, since a city population, despite the diversity of its arts, is somewhat overcrowded and is too near the hunger line to offer any security to the improvident. Physical anthropology has no knowledge of any chosen people, or of racial limitations of intelligence, that would prevent the exchange of ideas between men whose minds, like their tongues, have acquired a catholic function.

A bulletin (No. 75) issued for the Congress outlined the research work being carried out by the affiliated societies independently: it includes archæological excavations at Highdown Hill, Sussex, the application of science to animal welfare, ecological research at Limpsfield Common, observation of insect immigration, and the preparation of various lists of local flora and fauna upon the plan suggested by the Association for the Study of Systematics in Relation to General Biology. Certain centres where future congresses are likely to be held are preparing the material for the issue of local survey volumes, on the plan advocated by the British Association, in a uniform edition of which those for Hastings and Worthing have already been published under the sub-title "A Survey of Times Past and Present" (3*s*. 6*d*. net).

The annual report of the Insect Immigration Committee shows that by placing more reliance upon individuals keeping daily observation on schedules issued in each county, it will be possible to continue to collect records despite war conditions. The year 1939 was remarkable for the immigration of Large and Small White butterflies in southern England the larvæ of which ravaged market gardens more extensively than for the past twenty years; but as so large a percentage of the larvæ were parasitized, pest conditions are not expected to result this year. In France some 10 per cent damage was done by Painted Lady butterflies to globe artichoke plantations, but heavy rains practically wiped out the larvæ and only 4,500 butterflies of this species were recorded in the British Isles. Before May 1, 1940, the unusually large number of ninety Painted Lady butterflies were recorded, which either indicates a very early immigration from warmer climes or that the species can tolerate a dry winter, however cold, by hibernation like our Small Tortoiseshell.

The Congress hopes to meet next year in Brighton.

T. D.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING—The Registrar, College of Technology, Manchester (July 9).

ASSISTANT LECTURER IN ENGINEERING (MECHANICAL)—The Registrar, The University, Manchester 13 (July 13).

WORKSHOP INSTRUCTOR FOR ENGINEERING WORKSHOP PRACTICE AND WOODWORK, and a GRADUATE IN ENGINEERING OR SCIENCE TO TEACH MATHEMATICS AND SCIENCE, at the Schofield Technical Institute, Mexborough—The Secretary to the Managers, West Riding of Yorkshire Education Department, Education Office, Mexborough (July 13).

ASSISTANT TO THE ADVISORY OFFICER IN ANIMAL HUSBANDRY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (July 15).

PROFESSOR OF VETERINARY SURGERY, OBSTETRICS AND ANIMAL HUSBANDRY at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45, Upper O'Connell Street, Dublin (July 30).

PROFESSOR OF OBSTETRICS in the University of Sydney—The Secretary, Universities of the British Empire, 88a Gower Street, W.C.1 (September 30).

DIRECTOR OF SOCIAL STUDIES—The Registrar, University of Sydney, Sydney, New South Wales, Australia (September 30).

GRADUATE LECTURER IN MECHANICAL ENGINEERING at the Royal Technical College, Salford—The Acting Director of Education, Education Office, Chapel Street, Salford 3.

LECTURER (GRADE II) IN THE FACULTY OF ENGINEERING—The Secretary, University College, Gower Street, W.C.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich. Pp. 26. (Greenwich: Royal Observatory.) [46

Department of Scientific and Industrial Research. Report of the Building Research Board; with the Report of the Director of Building Research for the Year 1939. Pp. iii+60. (London: H.M. Stationery Office.) 1*s*. net. [106

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 9: Harmonic Riemannian Spaces. By E. T. Copson and H. S. Ruse. Pp. 117–133. 1*s*. 6*d*. Vol. 60, Part 1, No. 10: Interpolated Derivatives. By Dr. B. Spain. Pp. 134–140. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [106

Other Countries

U.S. Department of Agriculture. Circular No. 554: Honey and Pollen Plants of the United States. By Everett Oertel. Pp. 64. 10 cents. Technical Bulletin No. 716: Investigations on the Physical and Chemical Properties of Beeswax. By Charles S. Bisson, George H. Vansell and Walter B. Dye. Pp. 24. 5 cents. Technical Bulletin No. 721: *Paradexodes epilachnae*, a Tachinid Parasite of the Mexican Bean Beetle. By B. J. Landis and N. F. Howard. Pp. 32. (Washington, D.C.: Government Printing Office.) [36

Proceedings of the United States National Museum. Vol. 88, No. 3085: Two New Genera and Three New Species of Cheilodipterid Fishes, with Notes on the other Genera of the Family. By Leonard P. Schultz. Pp. 403–424. Vol. 88, No. 3086: A Contribution to the Knowledge of the *Eucharidae* (Hymenoptera: Chalcidoidea.) By A. B. Gahan. Pp. 425–458. Vol. 88, No. 3089: Notes on the Birds of Kentucky. By Alexander Wetmore. Pp. 529–574. (Washington, D.C.: Government Printing Office.) [36

Transactions of the San Diego Society of Natural History. Vol. 9, No. 16: A Race of the Warbling Vireo from Guerrero, Mexico. By A. J. van Rossem. Pp. 77–78. Vol. 9, No. 17: Notes on some North American Birds of the Genera Myiodynastes, Pitangus and Myiochanes. By A. J. van Rossem. Pp. 79–86. Vol. 9, No. 18: The Worm Snakes of the Genus *Leptotyphlops* in the United States and Northern Mexico. By Laurence M. Klauber. Pp. 87–162+plate 6. Vol. 9, No. 19: The Lyre Snakes (Genus *Trimorphodon*) of the United States. By Laurence M. Klauber. Pp. 163–194+plate 7. Vol. 9, No. 20: Two New Subspecies of *Phyllorhyncus*, the Leaf-nosed Snake, with Notes on the Genus. By Laurence M. Klauber. Pp. 195–214. (San Diego, Calif.: San Diego Society of Natural History.) [36

Contributions from the Biological Laboratory of the Science Society of China, Zoological Series. Vol. 13, No. 5: Study of some Forest Insects of Nanking and its Vicinity, Part 3: Observations on the Gypsy Moth (*Porthetria dispar* L.). By C. P. Miao. Pp. 57–78. Vol. 13. No. 6: Succinate Oxidation and the Inavailability of the Energy derived therefrom for the Activity of Frog Muscle poisoned with Iodoacetic Acid. By T. H. Chang and T. T. Yu. Pp. 79–86. Vol. 13, No. 7: A Note on the Vitamin C Content of some Dried, Sugared and Salted Chinese Vegetables and Fruits. By Libin T. Cheng and H. Tao. Pp. 87–90. Vol. 13, No. 8: A Dietary Study of the Middle-Class Chinese and Mohammedans in Sungpan. By Libin T. Cheng and Hsuo-Chi Ku. Pp. 91–100. (Shanghai: Science Society of China.) [36

Collected Papers from the Faculty of Science, Osaka Imperial University. Series C: Chemistry. Vol. 6, 1938. Pp. vi+35 papers. (Osaka: Osaka Imperial University.) [66

Regenwaarnemingen in Nederlandsch-Indië, 1937. Pp. 131. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [66

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Lecturer: J. SELWYN CASWELL, M.Sc.(Wales), A.M.I.Mech.E., A.M.Inst.C.E.
Assistant Lecturer: W. E. J. FARVIS, B.Sc.(Bristol).

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Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
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Further information regarding Matriculation, Scholarships, etc. may be obtained from the Secretary.

W. A. Fleming, Secretary to the University.

UNIVERSITY COLLEGE OF SWANSEA

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES)

Principal: C. A. EDWARDS, D.Sc., F.R.S.

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(*a*) Degrees of the University of Wales in Arts, in Pure Science and in Applied Science (Metallurgy, Engineering and Metallurgical Engineering);
(*b*) Diplomas of the College in Metallurgy and in Engineering;
(*c*) The training of teachers for elementary and secondary schools;
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Singleton Park,
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A. J. WILSON,
Secretary.

6 Blythswood Square,
GLASGOW. June 26, 1940.

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